INSTRUCTION BOOK

FOR

TYPES NC-2-40 and NC-2-40S RECEIVERS

AND

2-42 POWER UNIT

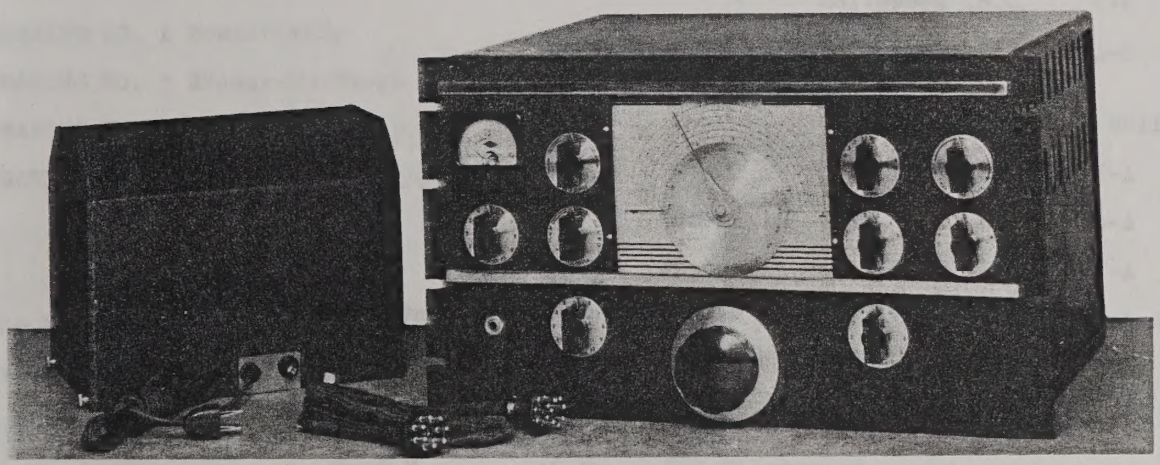

PHOTO NO. 1 NC-2-40 EQUIPMENT

Manufactured By

NATIONAL COMPANY, INC.
61 SHERMAN STREET
MALDEN, MASS., U.S.A.

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The NC-2-40S Receiver is a special model of the NC-2-40 having R.F. ranges and input impedances as listed below:

Band F	200 to 400 Kilocycles
Band E	490 to 1,060 Kilocycles
Band D	1,000 to 2,400 Kilocycles
Band C	2,200 to 5,000 Kilocycles
Band B	4,500 to 10,000 Kilocycles
Band A	9,000 to 18,000 Kilocycles

Input impedances at certain critical frequencies are approximately as follows: 1,000 ohms at 1638 Kc., 3,000 Kc., 5,400 Kc., and 8,220 Kc.; 300 ohms at 500 Kc.; 250 ohms at 275 Kc.

In general, all instruction book material pertaining to the NC-2-40 is applicable to the NC-2-40S if it is remembered that the R.F. transformers with associated fixed capacitors, and the main dial scale are different. When ordering replacement parts for the R.F. circuits, always specify the receiver model.

SECTION 1. DESCRIPTION

1-1 General

1-1-1 The NC-2-40 Radio Receiver is suitable for the reception of radio telephone and telegraph signals (either c.w. or m.c.w.) by either headphone or loud speaker methods. Each equipment consists of a receiver built for relay rack mounting, a separate a.c. operated power supply unit, interconnecting cable, and instruction book.

1-1-2 The Receiver is a twelve tube superheterodyne covering a continuous frequency range from 490 to 30,000 kilocycles in six bands as follows:

Frequency Range	Band
490 to 1,000 Kilocycles	F
1,000 to 2,000 Kilocycles	E
1.7 to 4.0 Megacycles	D
3.5 to 7.3 Megacycles	C
7.0 to 14.4 Megacycles	B
14.0 to 30.0 Megacycles	A

1-1-3 The circuit of the Receiver is shown in DWG NO. 1. It consists of one stage of radio frequency amplification, first detector (or mixer), high frequency oscillator, crystal filter, two stages of intermediate frequency amplification operating at 455 kc., an "infinite impedance" diode detector, an adjustable noise peak limiter, phase inverter first audio, and two audio output stages. A beat frequency oscillator is provided for the reception of c.w. signals. An amplified and delayed automatic volume control system is provided. Associated with the a.v.c. system is a signal strength meter calibrated in S-units from 1 to 9 and in db. above S-9 from 0 to 40 db.

1-1-4 The Type 2-42 Power Unit operates on either 115 or 230 Volts, 40/60 cycles to supply all voltages required by the receiver.

1-2 Output Circuits

1-2-1 A push-pull audio amplifier stage employing 6V6 tubes supplies audio power for loud speaker operation. An output coupling transformer provides two output impedances, 500 ohms and 8 ohms. Two pairs of terminals are mounted at the rear of the receiver chassis thus permitting connection to a 500 ohm line or to the 8 ohm voice coil of a loud speaker. One terminal of each pair is grounded to the chassis. Maximum undistorted output is approximately 6 watts.

1-2-2 An output amplifier stage employing a single 6J5 tube supplies power output for headphones. The output coupling transformer provides three load impedances: 125, 250 and 500 ohms. A headphone jack is mounted on the receiver front panel and is so wired that the input to the loud speaker output stage is disconnected when the phone plug is inserted. The 125 ohm load circuit is normally connected to the headphone jack. Maximum undistorted power output at the headphone jack is approximately 100 milliwatts.

1-3 Antenna Requirements

1-3-1 Antenna input terminals are located at the rear of the chassis near the center. The input circuit is suitable for use with a single-wire antenna, a balanced feed line or a concentric transmission line. The impedance of the antenna or transmission line at the rear input terminals should be from 300 to 500 ohms on the two low frequency bands of the receiver covering from 490 to 2,000 kc. Impedance at the input terminals should be approximately 72 ohms on the four high frequency bands of the receiver covering frequencies from 2 to 30 megacycles. The above impedance values are approximate and receiver performance will not be impaired if the impedance differs widely from these values. The impedance should not, however, be less than 60 ohms. In addition to the antenna input terminals, a short length of flexible lead is provided. This lead is permanently attached to the receiver chassis and permits either terminal to be grounded to the chassis if required.

1-4 Power Supply

1-4-1 The NC-2-40 Radio Receiving Equipment is built for operation from a 115 or 230 volt power source. See Par. 1-1-4. Normal power consumption is approximately 115 watts. The power supply circuits provide 4.6 amperes at 6.3 volts for the heater circuits and 120 milliamperes at 275 volts for the B circuits of the receiver.

1-4-2 All power leads and the a.c. switch leads are brought to a 7-prong socket mounted on the power unit chassis, interconnection between power unit and receiver being made by a shielded 6-wire cable having a 7-prong plug on each end.

1-4-3 A 2-ampere fuse is mounted on the power unit in a conventional fuse extractor post, the extractor element having a knurled thumbscrew to permit convenient removal of the fuse without the use of tools.

1-4-4 The NC-2-40 Receiver may be operated from batteries. With battery operation it is recommended that the two 6V6 output tubes be removed from the receiver in order to

provide maximum economy of battery power. Under these conditions, the heater drain is 3.5 amperes at 6 volts and the B circuit drain is 26 milliamperes at 180 volts.

1-4-5 If desired, the NC-2-40 Receiver may be operated from the 2-42 Power Unit with output tubes removed. In order to maintain normal B voltage on the tubes remaining in the receiver, a compensating resistance is incorporated in the filter circuit of the power unit. The terminals of this resistance are brought to a panel labeled "COMP. RES." which is normally fitted with a short-circuiting jumper. With the 6V6 tubes removed from the receiver, the compensating resistance should be connected in the power supply circuit by removal of the jumper.

1-5 Tube Complement

1-5-1 The tubes employed in the receiver are as follows:

R.F. Amplifier	V-1	6SK7
First Detector	V-2	6K8
H.F. Oscillator	V-3	6J5
First I.F. Amplifier	V-4	6K7
Second I.F. Amplifier	V-5	6SK7
Second Detector-Limiter	V-6	6C8G
Beat Frequency Oscillator	V-7	6SJ7
Automatic Volume Control	V-8	6SJ7
Audio Phase Inverter	V-9	6F8G
Speaker Output	V-10	6V6
Speaker Output	V-11	6V6
Headphone Output	V-12	6J5

1-5-2 One tube is employed in the Power Unit

Full-Wave Rectifier	V-13	80

SECTION 2. INSTALLATION

2-1 General

2-1-1 After unpacking the various components of the complete equipment, and after they have been placed in their operating positions, make interconnections between the radio receiver and the power unit sockets J-1 and J-2 by means of the shielded cable W-1. Before connecting the a.c. plug P-1 of the power unit to a suitable a.c. source, check the position of the switch S-9 of the 2-42 Power Unit. See Par. 2-1-2. See DWG. NO. 1 regarding the arrangement of pins of the cable connector plugs. Make an-

tenna connections in accordance with Par. 2-1-3 below. The speaker output circuit will utilize either the 500 ohm (E-3) or the 8 ohm (E-4) terminals, depending upon the installation. The loud speaker input impedance is normally 8 ohms so that direct connection may be made to the 8 ohm output terminals E-4 of the receiver. Before putting the receiver in operation, check to see that all tubes are firmly seated in their sockets.

2-1-2 The 2-42 Power Unit is fitted with a switch S-9; the switch in the "115" position provides for 105 to 125 volt operation; in the "230" position, for 210-250 volt operation. The switch is fitted with a locking device which must be released before changing switch positions. The lock should be replaced after the correct switch position has been chosen.

2-1-3 In an installation having a simple antenna-ground combination, connect the single wire lead-in to either of the two antenna input terminals E-1 and ground the other terminal to the chassis by means of the flexible lead referred to in Par. 1-3-1. In an installation having a balanced feed-line, connect the two leads directly to the two antenna input terminals E-1; the flexible grounding lead is not used. In an installation having a concentric feed-line, connect the inner conductor to one of the input terminals E-1 and the outer conductor to the other input terminal; connect the latter to the chassis by means of the flexible lead.

2-1-4 As mentioned in Par. 1-2-2, the headphone jack J-6 and terminal panel E-2 are normally wired to the 125 ohm tap of the phone output transformer T-4. Either of the other circuits, i.e., 250 ohm or 500 ohm, may be used to provide phone output by disconnecting the lead from terminal E-6 and connecting it to terminal E-7 or E-8 respectively.

2-1-5 It is recommended that the complete receiving equipment be connected to a positive earth ground. Terminal E-9 on the receiver chassis may be used for this purpose.

SECTION 3. OPERATING INSTRUCTIONS

3-1 Controls

3-1-1 The MAIN TUNING dial is located at the center of the front panel of the receiver. Six scales, reading directly in frequency, are provided for the six frequency ranges as listed in Par. 1-1-2. The dial drive is so arranged that the frequency to which the receiver tunes decreases with clockwise rotation of the tuning knob. The

accuracy of the dial calibration can be relied upon to approximately plus or minus 1%. In addition to the direct reading frequency scales, a numerical or logging dial is provided. This dial has a circular scale with 100 divisions; it revolves approximately 5-1/2 times when covering any one frequency range and is thus direct reading to about .2 of 1%.

3-1-2 The knob which is used for tuning also serves as the BAND SELECTOR knob. To change from one frequency band to an adjacent band, pull the knob away from the front panel until it has moved about 1/4 inch. This movement disengages the tuning mechanism and engages the band changing mechanism. After the knob is pulled out one complete turn will switch in an adjacent frequency band. A positive detent indicates when the switching operation is completed correctly. In addition, two markers appear on the face of the dial, one at each end of the frequency scale corresponding to the frequency band that has been selected. After selection of the desired frequency band, the knob must be pushed towards the panel, back to its original position, thus re-engaging the tuning mechanism.

3-1-3 The LIMITER control R-30 is used to adjust the d.c. potential applied to the elements of the limiter tube, one section of V-6. By this means, the limiter circuit is provided with adjustable threshold level at which limiting action starts. Any audio voltages or peaks in excess of this threshold level are prevented from reaching the audio amplifier. With the limiter control set at 0, the limiter circuits will pass all but the strongest noise peaks; when the control is set at 10, the threshold is lowered to a point where audio signals will be distorted due to the suppression of positive peaks.

3-1-4 The POWER SUPPLY switch control knob N-4 has three positions. When in the counterclockwise position, "OFF", the B supply circuits are opened by means of switch S-6, the primary circuit of the power supply is opened by means of switch S-7 and the heater circuit of the receiver is opened by means of switch S-8. In the "B+ OFF" position the switches S-7 and S-8 are closed completing the primary circuit of the power unit and the heater circuit of the receiver, switch S-6 remaining open. In the clockwise position switch S-6 is closed, completing the B supply circuit for normal operation of the receiver. The action of the POWER SUPPLY switch is similar to that described above when the receiver is operated from batteries, both heater and B supply circuits being open when the switch is in the counterclockwise position, "OFF".

3-1-5 The CONTROL SWITCH S-3, S-4 is located below the POWER SUPPLY switch. In the

"AVC" position, the automatic volume control system is operative, both S-3 and S-4 being open. In the central "MVC" position, S-4 is closed disabling the automatic volume control system, switch S-3 remaining open. In the "CWO" position, switch S-3 closes turning on the c.w. oscillator with automatic volume control turned off.

3-1-6 The R.F. GAIN control R-3 is used to regulate the amplification of the R.F. and I.F. amplifier tubes V-1, V-4 and V-5 by variation of cathode bias. Amplification increases as the control is turned clockwise towards 10 on the scale.

3-1-7 The A.F. GAIN control R-38 is a potentiometer providing adjustable attenuation of audio signal transfer from the output of the second detector-limiter V-6 to the audio phase inverter V-9. Audio amplification increases as the control is turned clockwise towards 10 on the scale.

3-1-8 The TONE control R-37 and S-5 is used to vary the frequency characteristic of the audio amplifier. When the control is set at position marked "N", the full audio frequency range of the receiver is available; in the "H" position audio frequencies below 100 cycles are attenuated, switch S-5 being open; as the control is turned clockwise toward the LOW position, audio frequencies above 1,000 cycles are increasingly attenuated.

3-1-9 The C.W. OSCILLATOR control C-37 is used for varying the frequency of the c.w. oscillator over a narrow range. The c.w. oscillator is tuned to the intermediate frequency at 0 on the C.W. OSCILLATOR scale. Turning the control in either direction from 0 to 5 changes the frequency of the c.w. oscillator approximately 6 kc.

3-1-10 The crystal filter SELECTIVITY control switch S-1 provides six degrees of I.F. selectivity; one with crystal filter off and five with crystal in. Typical selectivity curves are shown in DWG. NO. 2. Selectivity increases as the control is turned from "OFF" towards the number 5 position. In general, the switch positions "OFF", "1" and "2" are recommended for phone reception. Position 5 provides full single signal operation.

3-1-11 The crystal filter PHASING control C-16 is used to reject or attenuate a narrow band of frequencies within the band passed by the I.F. amplifier. The rejection characteristic can only be used, however, when the SELECTIVITY control is in other than the "OFF" position, i.e., when the crystal Y-1 is in use. Under these conditions, an undesired signal which is interfering with a properly tuned desired signal and causing a heterodyne or inverted speech can be eliminated by careful adjustment of the PHASING

control. Unstable interfering signals or those having appreciable frequency modulation cannot be eliminated since the rejection characteristic has high selectivity. The rejecting ability of the phasing circuit improves as the SELECTIVITY control is advanced towards position 5. The rejecting ability of the phasing circuit is minimum when the interfering signal is close in frequency to the desired signal. The PHASING control is normally set at 0 when the crystal filter is not in use, i.e., with SELECTIVITY control "OFF".

3-2 Phone or M.C.W. Reception

3-2-1 After the equipment is properly installed, in accordance with Section 2, it is placed in operation by turning the POWER SUPPLY switch to "B+ ON". The LIMITER control should be set at 0. The CONTROL SWITCH should be set at "AVC". The PHASING knob should be set at 0; the SELECTIVITY at "OFF"; the TONE control should be set to give the desired audio characteristic; the R.F. GAIN control should be advanced to some point between 8 and 10, depending upon receiving conditions; the A.F. GAIN control should be set at the point providing the desired audio volume. The receiver is now adjusted for the reception of phone signals and will tune to the frequency indicated by the MAIN TUNING dial. The C.W. OSC. knob has no influence on receiver performance.

3-2-2 With the CONTROL SWITCH set in the "AVC" position, as recommended, the R.F. GAIN knob should be advanced as far as receiving conditions permit, or until background noise becomes objectionably loud. Audio output should be adjusted entirely by means of the A.F. GAIN knob. The operator must remember that automatic volume control action will be restricted unless the R.F. GAIN knob is fully advanced.

3-2-3 The CONTROL SWITCH may be set at "MVC", in which case the operator must be careful not to advance the R.F. GAIN knob to a point where I.F. or audio amplifier overload occurs. Such overload is indicated by distortion. In general, the A.F. GAIN control may be set about halfway on, i.e., at 5, and the audio output adjusted by means of the R.F. GAIN control.

3-2-4 If a signal is weak and partially obscured by background noise and static, best signal-to-noise ratio will be obtained by turning the TONE control towards the "LOW" position. The most effective setting must be determined by trial as too much attenuation of high audio frequencies will impair the intelligibility of speech.

3-2-5 When a signal is accompanied by static peaks or noise pulses of high intensity and short duration, the best signal-to-noise ratio will be obtained by advancing the

LIMITER control towards 10. The best setting must be determined by trial as too much limiter action will impair audio quality. If static peaks and noise pulses are extremely strong or if they are of fairly long duration, the effectiveness of the limiter will be best with the CONTROL SWITCH in the "MVC" position. In such cases both R.F. GAIN and LIMITER controls must be carefully adjusted for optimum signal-to-noise ratio.

3-2-6 The selectivity of the receiver is increased when the crystal filter is switched into the circuit, i.e., the SELECTIVITY control at some position other than "OFF". The normal setting of the SELECTIVITY control in phone reception is at one of the positions affording broad selectivity. Positions 1 or 2 are recommended. Selectivity may be progressively increased by turning the SELECTIVITY control to positions 3, 4 and 5 although advancing the control too far will increase selectivity to a degree where phone signals become unintelligible.

3-2-7 The PHASING control is used to eliminate or attenuate heterodynes. The normal setting of the PHASING control in phone reception is at 0 on the scale. If, after a signal has been tuned in, an interfering signal causes a heterodyne or whistle, the PHASING control should be adjusted until the interference is reduced to a minimum. The setting of the PHASING control which provides maximum attenuation of the heterodyne will depend upon the pitch of the heterodyne whistle. If the beat note is above 1,000 cycles, the optimum PHASING control setting will be near 0; if the beat note is 300 or 400 cycles, the optimum PHASING control setting will be near one end of the scale or the other, depending upon whether the interfering signal has a higher or lower frequency than the desired signal.

3-2-8 It is recommended that the TONE control be set in the "HIGH" position when using the crystal filter in phone reception. The resulting attenuation of low audio frequencies tends to compensate for side-band cutting action of the crystal filter.

3-3 C.W. Reception

3-3-1 The initial adjustment of the receiver for c.w. reception is as described in Section 3-2, except that the CONTROL SWITCH must be in the "CWO" position. The c.w. OSC. control should be set at mid-scale.

3-3-2 The sensitivity of the receiver should be adjusted by means of the R.F. GAIN control, care being taken not to advance the control to the point where strong signals will cause I.F. or audio amplifier overload, as indicated by excessive thumping.

3-3-3 The action of the TONE and LIMITER controls will be similar to that described under Section 3-2. When receiving c.w. signals, it will be possible to advance both TONE and LIMITER controls considerably farther than is possiole in phone reception, since audio distortion is relatively unimportant.

3-3-4 Turning the C.W. OSC. control will change the characteristic pitch of the receiver background noise. The pitch will become higher as the beat frequency oscillator is detuned from the I.F. amplifier. With the C.W. OSC. control set at 2 or 3 (on either side of 0), the characteristic pitch of the receiver background noise will be in the neighborhood of 2,000 cycles. Under these conditions, the audio beat note of any c.w. signal will show a broad peak at approximately 2,000 cycles. This peak will appear on "one side of the carrier" only and the other side, where the audio beat note is around 2,000 cycles, will be considerably weaker. This characteristic, known as "semi-single signal", is helpful in receiving weak signals through interference.

3-3-5 As stated in Section 3-2, the selectivity of the receiver may be adjusted by means of the crystal filter, the action of the SELECTIVITY and PHASING controls in c.w. reception being similar to that described. It is possible, however, to utilize the full range of crystal filter selectivity in c.w. reception. Maximum selectivity is obtained with the SELECTIVITY control set at 5. With this setting the single-signal effect, outlined above, becomes very pronounced; in other words, the audio beat note is very sharply peaked at a definite audio frequency which is determined by the setting of the C.W. OSC. control. The operator may have difficulty in finding the audio peak when first attempting to use the crystal filter. After a signal has been accurately tuned to give peak response, the R.F. GAIN control may need to be retarded in order to prevent I.F. or audio overloading. With the receiver tuned to "crystal peak", an interfering signal may be attenuated by proper setting of the PHASING knob since this control does not appreciably affect the desired signal.

3-4 Measurement of Signal Strength

3-4-1 To make a measurement of signal strength by means of the S-meter, the R.F. GAIN control must be advanced to 10, and the CONTROL SWITCH set at the "AVC" position. The crystal filter should be turned "OFF" by means of the SELECTIVITY control; the PHASING knob set at 0. The TONE, LIMITER and A.F. GAIN controls do not affect the meter reading.

3-4-2 With no R.F. input to the receiver, or with the antenna disconnected, the S-

meter should read 0, plus or minus 1 S-unit. If it does not, the S-meter circuit requires adjustment. See Par. 4-6-1.

3-4-3 Measurement of the signal strength of c.w. signals cannot be made with the beat frequency oscillator in operation.

SECTION 4. ALIGNMENT

4-1 General

4-1-1 The SENSITIVITY vs. FREQUENCY curves of DWG. NO. 4 indicate the overall sensitivity of the average NC-2-40 Radio Receiver. These curves, together with the MAXIMUM NOISE LEVEL curves of DWG. NO. 3, provide data for definitely checking the Radio Receiver to determine if repairs or realignment are necessary, since the majority of circuit element failures, or any misalignment, will reduce both sensitivity and maximum noise level of the Equipment. The data referred to above will, therefore, also serve to show the efficacy of repairs or realignment.

4-1-2 The SELECTIVITY, IMAGE, ATTENUATION, FIDELITY and AVC characteristics of DWG. NOS. 2, 5, 6 and 7 are necessary where a particular performance check is desired, but are of secondary importance in most cases, since an Equipment having normal SENSITIVITY and MAXIMUM NOISE characteristics will, in all probability, be normal in all other respects.

4-1-3 Before proceeding with the alignment of any circuit of the Radio Receiver, the Equipment must be set up as specified in Section 2, "Installation", except that the antenna lead-in or transmission line must be disconnected. An output meter having the proper impedance should be connected to the phone output jack J-6. In this case, the speaker may remain connected to terminals E-3 or E-4. Alternatively, an output meter having the proper impedance may be connected to either of the speaker output terminals with the speaker disconnected. The R.F. GAIN control should be fully advanced and the POWER SUPPLY switch in the "B+ ON" position. The band selector knob must be set to connect one of the radio frequency bands; either the band upon which realignment is desired, or the band specified in any of the data in Sections 5 and 6. The TONE control should be set at "N" and the LIMITER at 0.

4-1-4 The complete alignment of the Radio Receiver may be divided into four steps:

(1) Intermediate Frequency Amplifier Alignment.

(2) H.F. Oscillator Alignment

(3) First Detector and R.F. Amplifier Alignment

(4) Tracking of H.F. Oscillator, First Detector and R.F. Amplifier circuits.

The circuits MUST be checked in the above order when complete alignment is necessary.

4-2 I.F. Amplifier Alignment

4-2-1 The intermediate frequency of the NC-2-40 Receiver is 455 kilocycles, plus or minus 2 kilocycles. The exact frequency is determined by the quartz crystal resonator Y-1.

4-2-2 Tuning capacitors are provided on the crystal filter and on each I.F. transformer. These capacitors are designated by symbol numbers C-13, C-21, C-22, C-25, C-27, C-31 and C-33 on PHOTO NOS. 4 and 6.

4-2-3 The high output lead of an accurately calibrated signal generator should be connected to the grid terminal of the first detector tube V-2 and the grounded lead to any convenient point on the chassis. The flexible lead need not be disconnected from the grid of the tube. Connection is made directly from the output jack of the signal generator, the dummy antenna being omitted. The CONTROL SWITCH of the receiver should be in the "CWO" position and the modulation of the signal generator turned off to provide a steady c.w. test signal. The PHASING control of the receiver should be set at 0 and the SELECTIVITY control at 5. The A.F. GAIN control should be fully advanced to 10.

4-2-4 Adjust the output attenuator of the signal generator to provide a signal of approximately 100 microvolts and vary the tuning control of the signal generator slowly between the frequencies of 453 and 457 kilocycles. At some frequency between these limits the I.F. amplifier of the receiver will show a very sharply peaked response, as indicated on the output meter. The output attenuator of the signal generator should be retarded after the signal generator has been tuned to the I.F. peak in order to avoid I.F. or audio overload; the C.W. OSC. control must be set to provide an audio beat note in the middle of the audio range (between 400 and 1,000 cycles).

4-2-5 The I.F. tuning capacitors C-13, C-25, C-27, C-31 and C-33 should each be carefully adjusted to give a maximum reading on the output meter. The order in which the adjustments are made is not important. While making I.F. amplifier adjustments, it will be necessary to retard the attenuator of the signal generator if the readjustment increases I.F. amplifier gain to the point where overload occurs.

4-2-6 The crystal filter SELECTIVITY knob should then be set at 1 and the signal generator detuned between 3 and 4 kilocycles either side of the crystal frequency. Capacitor C-22 should be tuned for maximum output meter reading. After this adjustment is made, the SELECTIVITY knob should be set at "OFF" and the signal generator retuned to exact crystal frequency. Compensator capacitor C-21 should then be adjusted for maximum reading on the output meter.

4-2-7 The performance of the I.F. amplifier and audio circuits may be checked against the stage gain data in Section 5.3 after alignment has been completed. Selectivity may be checked against the curves of DWG. NO. 2.

4-2-8 After alignment of the I.F. amplifier has been completed, the C.W. OSC. control should be set at 0 at which setting the c.w. oscillator should be at zero beat with the test signal. If zero beat does not occur at 0, readjust capacitor C-36 of transformer T-3 as shown in PHOTO NO. 4.

4-2-9 The quartz crystal resonator Y-1 may be checked at the conclusion of I.F. amplifier alignment as follows: The SELECTIVITY control should be set at 5 and the signal generator tuned to the crystal frequency. The output meter reading should be noted. When the SELECTIVITY knob is turned to "OFF", the meter reading should decrease 1 to 2 db. provided the PHASING knob is at 0. An increase in meter reading can, in most cases, be traced to an improper adjustment in the I.F. amplifier, since the crystal resonator is mounted in a sealed holder, and it is rather unlikely that trouble will be had from that source.

4-3 H.F. Oscillator Alignment

4-3-1 If, after I.F. alignment is completed, test results compared with the performance data, drawings, etc., indicate that alignment of any high frequency circuit is necessary, the procedure is as outlined in the following paragraphs.

4-3-2 The coil group which is plugged into the circuit at any time is the one directly underneath the three-gang tuning capacitor at the center of the chassis. The coil nearest the front of the receiver is in the high frequency oscillator circuit, the middle coil is in the first detector circuit, and the coil nearest the antenna-ground binding post strip E-1 is in the R.F. amplifier circuit. See PHOTO NO. 5.

4-3-3 Set the tuning dial near the high frequency end of the range and check the dial reading by means of an accurate signal generator or a signal of known frequency. Re-

adjustment should be made if the dial reading is in error by more than plus or minus 1 per cent.

4-3-4 Errors in frequency calibration at the high frequency end of the dial scale are corrected by adjustment of the H.F. oscillator trimmer capacitor C-7 of the band in question. A screw driver having a metal shaft may be used to make the adjustment, but the shaft should not touch any part of the aluminum coil catacomb. If the dial reading of the receiver is too high, the capacity of the H.F. oscillator trimmer must be decreased to make correction. Conversely, low dial readings are corrected by increasing the capacity of the H.F. oscillator trimmer capacitor C-7.

4-3-5 It is imperative that the high frequency oscillator circuits operate at a higher frequency than that of the R.F. amplifier circuits. This can be checked by tuning in the image signal, which should appear at a dial reading approximately 910 kilocycles below that of the real signal. The image signal should be considerably weaker (see DWG. NO. 5) if the R.F. amplifier is correctly aligned and a stronger test signal may be required before the image can be found. If the image does not appear at the lower frequency dial setting, the H.F. oscillator circuit is incorrectly adjusted and the capacity of the H.F. oscillator trimmer capacitor in question must be decreased until the real signal and image signal appear at the proper points on the dial.

4-4 First Detector and R.F. Amplifier Alignment

4-4-1 With the test signal from the signal generator adjusted to provide a modulated signal near the high frequency limit of the band to be checked, tune the receiver to give maximum output, as indicated by the output meter. The first detector and R.F. trimmer capacitors C-1 and C-5 of the band in question may now be adjusted to give maximum output meter readings. On the highest frequency bands, adjustment of the first detector and R.F. trimmers may change the calibration of the high frequency oscillator, necessitating readjustment of the tuning dial to keep the receiver in tune with the test signal. If trimmers C-1 and C-5 should require considerable realignment, it may be necessary to readjust the high frequency oscillator trimmer C-7 in order to maintain correct calibration.

4-4-2 A very simple and quick method of first detector and R.F. trimmer alignment may be used if a signal generator is not available. This method consists of setting trimmers C-1 and C-5 at the adjustment which provides maximum circuit or background noise. It will be found that trimmer settings under this method are sufficiently sharp to

provide good alignment, although the adjustment must be made with care to avoid alignment to the image frequency.

4-5 Tracking of High Frequency Circuits

4-5-1 After the H.F. oscillator and R.F. amplifier trimmers have been checked in accordance with Sections 4-3 and 4-4, near the high frequency limit of the band under test, the receiver should be tuned to a frequency near the low frequency end of the band. Tracking and calibration at any point up to the low frequency limit may be checked by adjusting the signal generator to the proper frequency and testing the settings of high frequency circuit trimmers. After such a test, all trimmers checked should be reset at the high frequency end of the band. A simpler and quicker tracking check may be made by bending the outside rotor plates of each section of the main tuning capacitor in turn so that the maximum capacity of each circuit may be increased or decreased by a small amount. The rotor plates must not be bent so much that they will not return to their original positions when pressure is removed. Any change in capacity in any section of this capacitor should decrease the sensitivity of the receiver.

4-5-2 Variable series padding capacitors (C-8A) are used to obtain correct calibration at the low frequency ends of the E and F ranges. If the dial reading is too low, the capacity of C-8A should be increased, and vice versa.

4-5-3 In order to determine if one or more sections of the main tuning capacitor are the cause of any mistracking present, it is necessary to make the check described in Par. 4-5-1 on two or more different bands. If the same tracking error appears on all bands, the main tuning capacitor is definitely at fault. The error should be corrected by permanently bending the rotor or stator plates to provide the proper capacity.

4-5-4 If the tracking error appears only in the H.F. oscillator, first detector or R.F. amplifier stage and on only one band, the inductance of the tuned circuit of that stage is incorrect. If the tracking check of Par. 4-5-1 shows that more capacity is needed for correct alignment, the inductance in question is too low, and vice versa. After any adjustment of inductance, the associated trimmer capacitor must be readjusted at the high frequency end of the band, as explained under Par. 4-3-4 or 4-4-1. Tracking should then be checked again at the low frequency end of the band.

4-6 S-Meter Adjustment

4-6-1 The S-meter balancing resistor R-25 is used to obtain zero meter reading in the

absence of signal input to the receiver. The adjustment is as follows: set the R.F. GAIN at 10, CONTROL SWITCH at "MVC", and disconnect the antenna leads; adjust R-25 until the S-meter M-1 reads zero.

SECTION 5. SERVICE AND TEST DATA

5-1 General

5-1-1 Even though all component parts of the receiver have an ample factor of safety, failure may occur in certain individual cases. Of these failures, the most common will probably be due to some defect in one of the tubes. Measurement of voltages in accordance with the data of Par. 5-2-2, will show which tube is bad. If the failure is a short in either the plate or screen circuits, the filter resistors associated with the circuit in question should be checked for possible burnout. Similarly, should any by-pass capacitor fail, any filter or voltage divider resistors which are connected in series with it should be checked for any change in resistance which may result from the overload.

5-1-2 Other possible failures, such as open circuits caused by poor connections, can likewise be located by voltage tests in accordance with the tabulation of Par. 5-2-2. Open by-pass capacitors are apt to cause either a loss of sensitivity, or oscillation in some portion of the circuit. In such cases, the fault can be easily located by temporarily connecting a good capacitor in parallel with each unit that is under suspicion.

5-1-3 Intermittent or noisy operation of the receiver is usually caused by a poor connection in either the wiring or in one of the tubes. Such a fault is often rather difficult to find, but can usually be located by lightly tapping each circuit element or component with a piece of insulating material.

5-2 Tube Socket Voltages

5-2-1 The TUBE SOCKET VOLTAGES table 5-2-2 must not be considered as a list of the actual operating voltages in the various circuits of the Radio Receiver. The resistance of the measuring instruments, together with capacitive and resistive loading effects, will disturb many of the circuits to such an extent that they become inoperative, thus altering normal voltage and current distribution.

5-2-2 TUBE SOCKET VOLTAGES

TUBE TERMINAL	SOCKET PIN NO.	VOLTAGE DC VOLTS	REF.	TUBE TERMINAL	SOCKET PIN NO.	VOLTAGE DC VOLTS	REF.
V-1 Grid	4	0		V-6 Cathode	4	0	E
V-1 Cathode	5	3	A	V-6 Plate	3	0	E
V-1 Cathode	5	27	A D	V-7 Grid	4		C
V-1 Screen	6	75	B	V-7 Cathode	5	0	G
V-1 Plate	8	225	B	V-7 Screen	6	12	A G
V-2 Grid	Cap	0		V-7 Plate	8	25	A G
V-2 Cathode	8	1	A	V-8 Grid	4	-32	A F
V-2 Screen	4	65	B	V-8 Cathode	5	-50	B F
V-2 Plate	3	220	B	V-8 Screen	6	0	F
V-3 Grid	5		C	V-8 Plate	8	0	F
V-3 Cathode	8	0		V-9 Grids	Cap, 5	0	
V-3 Plate	3	70	B	V-9 Cathode	4,8	4	A
V-4 Grid	Cap	0		V-9 Plates	3,6	115	B
V-4 Cathode	8	3	A	V-10 Grid	5	-24	A
V-4 Cathode	8	27	A D	V-10 Cathode	8	-44	A
V-4 Screen	4	75	B	V-10 Screen	4	225	B
V-4 Plate	3	215	B	V-10 Plate	3	215	B
V-5 Grid	4	0		V-11 Grid	5	-24	A
V-5 Cathode	5	4	A	V-11 Cathode	8	-44	A
V-5 Cathode	5	27	A D	V-11 Screen	4	225	B
V-5 Screen	6	80	B	V-11 Plate	3	215	B
V-5 Plate	8	220	B	V-12 Grid	5	0	
V-6 Grid	5	0		V-12 Cathode	8	7	A
V-6 Cathode	8	7	A	V-12 Plate	3	220	B
V-6 Plate	6	220	B	B+ Common		225	B
V-6 Grid	Cap	-5	A	B- Common		-60	B
V-6 Cathode	4	-8	A				

All measurements made with equipment connected for normal operation. A.C. supply voltage in accordance with Par. 2-1-2.

Voltage measurements made with a D.C. Voltmeter (Weston Model 489) 1,000 ohms per volt, between terminal and chassis. Due to normal tolerances in circuit components and tubes, the readings as listed are subject to a variation of plus or minus 15%. Unless otherwise specified control settings are as follows: R.F. GAIN at 9, A.F. GAIN

at 10, LIMITER at 0, CONTROL SWITCH at MVC, TONE control at N, BAND SELECTOR on 490 to 1,000 Kc. range, TUNING dial at 1,000 Kc.

REFERENCES

A - 0-50 Volt scale.

B - 0-250 Volt scale.

C - Accurate measurement cannot be made.

D - R.F. GAIN at 0.

E - LIMITER at 10.

F - CONTROL SWITCH at AVC.

G - CONTROL SWITCH at CWO.

5-3 Stage Gain Measurements

5-3-1 The sensitivity measurements listed below are useful in localizing the failure in a particular stage of the receiver or in determining the necessity for I.F. amplifier realignment. The receiver is set up in accordance with Par. 4-1-3. A signal generator is set up with the high output lead connected directly to the grid of the tube specified in the list under Par. 5-3-2. No dummy antenna is used. The test signal is 455 plus or minus 2 kc. (depending upon exact crystal frequency) modulated 30% 400 cycles. Set the various controls as follows: R.F. GAIN at 10, A.F. GAIN at 10, CONTROL SWITCH at "MVC", LIMITER at 0, TONE at "N", SELECTIVITY at "OFF", PHASING at 0, TUNING dial and BAND SELECTOR at 1,000 kc.

5-3-2 With 30 milliwatt output at the phone jack J-6 or phone terminals E-2, or with 1 watt output at either of the speaker terminals E-3, E-4, the test signal should be as listed below.

TERMINAL	TEST SIGNAL
V-2 Grid	20 ± 10 Microvolts
V-4 Grid	350 ± 100 Microvolts
V-5 Grid	45,000 ± 15,000 Microvolts
V-6 Grid	Over 1 Volt

SECTION 6. PARTS LIST

6.1 Receiver and Power Supply

SYMBOL NUMBER	FUNCTION	DESCRIPTION	MFR.	MFR. TYPE NO.	NATIONAL DWG. NO.
		STRUCTURAL PARTS			
A-1	Dial Window	Isinglass	A	MDW-240	C543-1
A-2	Dial Pointer	Metal Pointer	A	MDP-240	SA3203
A-3	Trim Strip	Chromium Plated, 17 1/2"	A	CTS-240	F194-1
		CAPACITORS			
C-a	R.F. Amp. Tuning	Variable Air: 225 mmf.)	A	NPW-240	SA:1031
C-b	First Det. Tuning	Same as C-a (Ganged)			
C-c	H.F. Osc. Tuning	Same as C-a)			
C-1	R.F. Amp. Trimmer	Variable Air: See Note 1	A	None	
C-1a°	R.F. Amp. Padder	Mica: .0009 mfd., 500 VDCW	S	1468	D774-2
C-2	V-1 Grid Filter	Mica: .005 mfd., 300 VDCW	S	1467	D775-16
C-3	V-1 Cathode By-pass	Paper: .1 mfd., 400 VDCW	L	G	D827-11
C-4	V-1 Screen By-pass	Paper: .1 mfd., 400 VDCW	L	G	D827-11
C-5	First Det. Trimmer	Variable Air: See Note 1	A	None	
C-6	V-1 B+ By-pass	Paper: .1 mfd., 600 VDCW	L	G	D827-13
C-7	H.F. Osc. Trimmer	Variable Air: See Note 1	A	None	
C-7a*	H.F. Osc. Temp. Comp.	Ceramic: 6 mmf., 500 VDCW	N	N-6801	F912-2
C-8	H.F. Osc. Padder	Mica: See Note 1			
C-8a#	H.F. Osc. Padder	Variable Air: See Note 1	A	None	
C-9	V-2 Cathode By-pass	Paper: .1 mfd., 400 VDCW	L	G	D827-11
C-10	V-2 Screen By-pass	Paper: .1 mfd., 400 VDCW	L	G	D827-11
C-11	V-2 B+ By-pass	Paper: .1 mfd., 600 VDCW	L	G	D827-13
C-12	V-3 Grid	Ceramic: .0001 mfd., 500 VDCW	M	810	D825C-304
C-13	CF-1 Input Tuning	Variable Air: 6 to 85 mmf.	A		SA:1841
C-14	CF-1 Input Bridge	Ceramic: 47 mmf., 500 VDCW			J695-1
C-15	CF-1 Input Bridge	Ceramic: 62 mmf., 500 VDCW			J695-3
C-16	CF-1 Phasing Control	Variable Air: 5 and 5 mmf.	A	UX-10	SA:3655
C-17	CF-1 Coupling	Inter-Sectional Coupling (Part of S-1)	-	- -	
C-18	CF-1 Selectivity Control	Ceramic: 5 mmf., 500 VDCW	M	813	D825D-401
C-19	CF-1 Selectivity Control	Ceramic: 10 mmf., 500 VDCW	M		D825D-426

SYMBOL NUMBER	FUNCTION	DESCRIPTION	MFR.	MFR. TYPE NO.	NATIONAL DWG. NO.
		CAPACITORS (CONT'D)			
C-20	CF-1 Selectivity Control	Ceramic: 10 mmf., 500 VDCW	M		D825D-4
C-21	CF-1 Compensating	Variable Mica: 3 to 30 mmf.	A	M30	D832-2
C-22	CF-1 Output Tuning	Variable Air: 6 to 85 mmf	A	None	SA:1841
C-23	V-4 Grid Filter	Paper: .01 mfd., 600 VDCW	L	G	D827-7
C-24	V-4 Cathode By-pass	Paper: .1 mfd., 400 VDCW	L	G	D827-11
C-25	T-1 Primary Tuning	Variable Air: 6 to 85 mmf.	A		SA:1841
C-26	V-4 B+ By-pass	Paper: .1 mfd., 600 VDCW	L	G	D827-13
C-27	T-1 Secondary Tuning	Variable Air: 6 to 85 mmf.	A		SA:1841
C-28	V-5 Grid Filter	Paper: .01 mfd., 600 VDCW	L	G	D827-7
C-29	V-5 Cathode By-pass	Paper: .1 mfd., 400 VDCW	L	G	D827-11
C-30	V-5 Screen By-pass	Paper: .1 mfd., 400 VDCW	L	G	D827-11
C-31	T-2 Primary Tuning	Variable Air: 6 to 85 mmf.	A		SA:1841
C-32	V-5 B+ By-pass	Paper: .1 mfd., 600 VDCW	L	G	D827-13
C-33	T-2 Secondary Tuning	Variable Air: 6 to 85 mmf.	L		SA:1841
C-34	V-6 Plate By-pass	Paper: .01 mfd., 600 VDCW	L	G	D827-7
C-35	V-7 Grid	Mica: .001 mfd., 500 VDCW	S	1460	J666-14
C-36	T-3 Tuning	Variable Air: 6 to 85 mmf.	A		SA:4377
C-37	C.W. Osc. Vernier	Variable Air: 2 to 10 mmf.	A	UMA-10	SA:893
C-38	V-7 Screen By-pass	Paper: .1 mfd., 400 VDCW	L	G	D827-11
C-39	V-7 to V-6 Coupling	Ceramic: 1.25 mmf.	N	K	F912-1
C-40	V-6 to V-8 Coupling	Ceramic: 47 mmf., 500 VDCW			J695-1
C-41	V-8 Cathode By-pass	Paper: .1 mfd., 400 VDCW	L	G	D827-11
C-42	B Minus to Chassis By-pass	Elec.: 8 mfd., 250 VDCW	B	BR-825	E338-2
C-43	A.V.C. By-pass	Paper: .1 mfd., 400 VDCW	L	G	D827-11
C-44	V-8 Plate By-pass	Paper: .1 mfd., 400 VDCW	L	G	D827-11
C-45	V-6 Cathode By-pass	Ceramic: .00025 mfd., 500 VDCW	M	810	D825C-3
C-46	V-6 I.F. By-pass	Mica: .001 mfd., 500 VDCW	B	1W	J666-14
C-47	Sec. Det. to Limiter Audio Coupling	Paper: 1 mfd., 200 VDCW	L	G	D827-21
C-48	Limiter Output By-pass	Ceramic: .00025 mfd., 500 VDCW	M	810	D825C-3
C-49	Tone Control	Paper: .01 mfd., 600 VDCW	L	G	D827-7
C-50	V-6 to V-9 Audio Coupling	Paper: .01 mfd., 600 VDCW	L	G	D827-7
C-51	Tone Control	Mica: .001 mfd., 500 VDCW	B	1W	J666-14

SYMBOL NUMBER	FUNCTION	DESCRIPTION	MFR.	MFR. TYPE NO.	NATIONAL DWG. NO.
		CAPACITORS (CONT'D)			
C-52	V-9 Cathode By-pass	Elec: 10 mfd., 50 VDCW	B	FA10003	E340-1
C-53	V-12 Cathode By-pass	Elec: 10 mfd., 50 VDCW	B	FA10003	E340-1
C-54	V-9 Feedback Coupling	Paper: .1 mfd., 400 VDCW	L	G	D827-11
C-55	V-9 to V-10 Coupling	Paper: .1 mfd., 600 VDCW	L	G	D827-13
C-56	V-9 to V-11 Coupling	Paper: .1 mfd., 600 VDCW	L	G	D827-13
C-57	B+ Power Filter	Oil: 4 mfd., 600 VDCW	B	VC1247A	E333-9
C-58	B+ Power Filter	Oil: 4 mfd., 600 VDCW	B	VC1247A	E333-9
C-59	B+ Power Filter	Oil: 4 mfd., 600 VDCW	B	VC1247A	E333-9
C-60	B+ Power Filter	Oil: 4 mfd., 600 VDCW	B	VC1247A	E333-9
		MISCELLANEOUS ELECTRICAL PARTS			
E-1	Antenna Input	Insulated Terminal Panel	A	FWK	SA:21
E-2	Headphone Output	TEL Terminal Panel	E	1720	E265-9
E-3	Speaker Output (500 Ohm)	SPKR Terminal Panel	E	1720	E265-16
E-4	Speaker Output (8 Ohm)	SPKR Terminal Panel	E	1720	E265-14
E-5	R-50 and R-51 Shunt	COMP. RES. Terminal Panel	E	1720	E265-20
E-6	T-4 Output (125 Ohm)	Insulated Lug) 3 Terminal	E	1531	D947-8
E-7	T-4 Output (250 Ohm)	Insulated Lug (Assembly			
E-8	T-4 Output (500 Ohm)	Insulated Lug)			
E-9	Chassis Ground	Screw Terminal	A	HC-LUG	E604-1
		FUSES			
F-1	A.C. Line	Glass Enclosed: 2 A., 250 V	C	3AG	F135-4
		INDICATING DEVICES			
I-1	M-1 Illuminator Lamp	Screw Base 6-8 V., .15 A	D	40	F136-1
I-2	Dial Illuminator Lamp	Bayonet Base 6-8 V., .15 A	D	47	F136-6
I-3	Dial Illuminator Lamp	Bayonet Base 6-8 V., .15 A	D	47	F136-6
		JACKS AND RECEPTACLES			
J-1	Receiver Power Input	Seven-prong Fiber Socket	E	U-18	E322-1
J-2	Power Supply Output	Seven-prong Fiber Socket	E	U-18	E322-1
J-3	Dummy Socket	Seven-prong Fiber Socket	E	U-18	E322-1

SYMBOL NUMBER	FUNCTION	DESCRIPTION	MFR.	MFR. TYPE NO.	NATIONAL DWG. NO.
		JACKS AND RECEPTACLES (CONT'D)			
J-4	Not used				
J-5	F-1 Holder	Extractor Post	C	1075A	E510-1
J-6	Headphone Output	Multi-Circuit Jack	F	B-114614-0	F183-1
		A.F. REACTORS			
L-1	Power Supply Filter	17 H., 100 MA.	A	80	SA:3927
L-2	Power Supply Filter	17 H., 100 MA.	A	80	SA:3927
		METERS			
M-1	Signal Strength	0 to 1 Milliameter	G	52S	F193-1
		DIALS AND KNOBS			
N-1	Main Calibration Dial	Etched Scale	A	MDS-240	C783-1
N-2	Auxiliary Logging Dial	Etched Dial	A	VDS-240	C782-1
N-3	Tuning and Band Change Knob	Bakelite Knob, 1/4" Shaft	A	HRK-200	SA:1586
N-4	Panel Control Knobs	Bakelite Knob with Pointer	A	HRP-P	SA:2
N-5	Limiter Dial	Etched, German-Silver	A	LCD-240	C444-1
N-6	Power Supply Dial	Etched, German-Silver	A	PSD-240	C444-2
N-7	Control Dial	Etched, German-Silver	A	CD-240	C444-3
N-8	R.F. Gain Dial	Etched, German-Silver	A	RFGD-240	C444-4
N-9	Phasing Dial	Etched, German-Silver	A	PD-240	C444-8
N-10	Selectivity Dial	Etched, German-Silver	A	SD-240	C444-9
N-11	A.F. Gain Dial	Etched, German-Silver	A	AFGD-240	C444-5
N-12	Tone Dial	Etched, German-Silver	A	TD-240	C444-6
N-13	C.W. Osc. Dial	Etched, German-Silver	A	CWOD-240	C444-7
		MECHANICAL PARTS			
O-1	Pinion Gear	12-Tooth Gear	A	CBP-200	C166-1
O-2	Gear Rack	9-Inch Gear Rack	A	CBR-200	C123-1
O-3	Catacomb Rod	7/16" Diam., 16-7/8" Length	A	ROD-100	C903-2
		PLUGS			
P-1	W-3 Connector	Two-Prong 660 W, 250 V.		Part of W-3	

SYMBOL NUMBER	FUNCTION	DESCRIPTION	MFR.	MFR. TYPE NO.	NATIONAL DWG. NO.
		RESISTORS			
R-1	V-1 Cathode Bias	470 Ohm, 1/2 Watt	H	BT-1/2	J569-21
R-2	V-1 Grid Filter	470,000 Ohm, 1/2 Watt	H	BT-1/2	J569-57
R-3	R.F. Gain Control	10,000 Ohm, W.W. Rheostat	I	G-59	F518-1
R-4	R-3 Bleeder	47,000 Ohm, 1/2 Watt	H	BT-1/2	J569-45
R-5	V-2 Cathode Bias	220 Ohm, 1/2 Watt	H	BT-1/2	J569-17
R-6	V-2 Screen Dropping	47,000 Ohm, 1/2 Watt	H	BT-1/2	J569-45
R-7	V-2 Screen Bleeder	100,000 Ohm, 1/2 Watt	H	BT-1/2	J569-49
R-8	V-2 Plate Filter	2,200 Ohm, 1/2 Watt	H	BT-1/2	J569-29
R-9	V-3 Plate Filter	47,000 Ohm, 1 Watt	H	BT-1	J571-45
R-10	V-3 Grid	47,000 Ohm, 1/2 Watt	H	BT-1/2	J569-45
R-11	V-4 Grid Filter	470,000 Ohm, 1/2 Watt	H	BT-1/2	J569-57
R-12	V-4 Cathode Bias	See Note 2	H	BT-1/2	
R-13	V-4 Plate Filter	2,200 Ohm, 1/2 Watt	H	BT-1/2	J569-29
R-14	V-7 Grid	47,000 Ohm, 1/2 Watt	H	BT-1/2	J569-45
R-15	V-7 Screen Bleeder	100,000 Ohm,1/2 Watt	H	BT-1/2	J569-49
R-16	V-7 Screen Dropping	100,000 Ohm, 1/2 Watt	H	BT-1/2	J569-49
R-17	V-7 B+ Filter	220,000 Ohm, 1/2 Watt	H	BT-1/2	J569-53
R-18	V-5 Grid Filter	470,000 Ohm, 1/2 Watt	H	BT-1/2	J569-57
R-19	V-5 Cathode Bias	See Note 2	H	BT-1/2	
R-20	B+ Voltage Divider	18,000 Ohm, 2 Watt	H	BT-2	J572-40
R-21	B+ Voltage Divider	18,000 Ohm, 2 Watt	H	BT-2	J572-40
R-22	V-5 Screen Bleeder	100,000 Ohm, 1/2 Watt	H	BT-1/2	J569-49
R-23	V-5 Screen Dropping	68,000 Ohm, 1/2 Watt	H	BT-1/2	J569-47
R-24	M-1 Bridge	1,000 Ohm, 1/2 Watt	H	BT-1/2	J569-25
R-25	M-1 Zero Adjustment	1,000 Ohm, W.W. Pot.	I	MH-1000	D831-2
R-25a	M-1 Range Adjustment	250/750 Ohm, 1/2 Watt	H	BT-1/2	
R-26	V-6 Plate Filter	2,200 Ohm, 1/2 Watt	H	BT-1/2	J569-29
R-27	V-6 (Det.) Load	22,000 Ohm, 1/2 Watt	H	BT-1/2	J569-41
R-28	V-6 I.F. Filter	4,700 Ohm, 1/2 Watt	H	BT-1/2	J569-33
R-29	V-6 (Lim.) Input	47,000 Ohm, 1/2 Watt	H	BT-1/2	J569-45
R-30	Noise Limiter Control	10,000 Ohm, W.W. Rheostat	I	G-60	D771-4
R-31	V-6 (Lim.) Output	47,000 Ohm, 1/2 Watt	H	BT-1/2	J569-45
R-32	A.V.C. Filter	470,000 Ohm, 1/2 Watt	H	BT-1/2	J569-57

SYMBOL NUMBER	FUNCTION	DESCRIPTION	MFR.	MFR. TYPE NO.	NATIONAL DWG. NO.
		RESISTORS (CONT'D)			
R-33	V-8 Grid	47Megohm, 1/2 Watt	H	BT-1/2	J569-69
R-34	V-8 Cathode Bias	270 Ohm, 2 Watt	H	BW-2	J572-18
R-35	A.V.C. Voltage Divider	1,500 Ohm, 2 Watt	H	BT-2	J572-27
R-36	V-8 Plate	470,000 Ohm, 1/2 Watt	H	BT-1/2	J569-57
R-37	Tone Control	500,000 Ohm, Comp. Pot.	M	2012076	F492-1
R-38	A.F. Gain Control	500,000 Ohm, Comp. Pot.	M	10101635	D833-2
R-39	V-12 Grid	470,000 Ohm, 1/2 Watt	H	BT-1/2	J569-57
R-40	V-9 to V-12 Coupling	470,000 Ohm, 1/2 Watt	H	BT-1/2	J569-57
R-41	V-12 Cathode Bias	1,000 Ohm, 1/2 Watt	H	BT-1/2	J569-25
R-42	V-9 Grid	470,000 Ohm, 1/2 Watt	H	BT-1/2	J569-57
R-43	V-9 Cathode Bias	1,000 Ohm, 1/2 Watt	H	BT-1/2	J569-25
R-44	V-9 Plate	47,000 Ohm, 1/2 Watt	H	BT-1/2	J569-45
R-45	V-9 Plate	47,000 Ohm, 1/2 Watt	H	BT-1/2	J569-45
R-46	V-9 Feedback Coupling	220,000 Ohm, 1/2 Watt	H	BT-1/2	J569-53
R-47	V-11 Grid	220,000 Ohm, 1/2 Watt	H	BT-1/2	J569-53
R-48	V-10 Grid	220,000 Ohm, 1/2 Watt	H	BT-1/2	J569-53
R-49	V-10 and V-11 Cathode Bias	220 Ohm, 2 Watt	H	BW-2	J572-17
R-50	Voltage Compensating	1,000 Ohm, 2 Watt	H	BT-2	J572-25
R-51	Voltage Compensating	1,000 Ohm, 2 Watt	H	BT-2	J572-25
R-52	Power Supply Bleeder	47,000 Ohm, 2 Watt	H	BT-2	J572-45
R-53	Power Supply Bleeder	47,000 Ohm, 2 Watt	H	BT-2	J572-45
		SWITCHES			
S-1	Selectivity Control	Dual-Section, 6-position	M	CFW-4393-AS	E195-3
S-2	Meter "ON-OFF"	S.P.S.T. (Part of R-3)			
S-3	C.W. Osc. "ON-OFF"	S.P.S.T. 1A., 250 V.)	Ganged J	1570NJ	E949-2
S-4	A.V.C.-M.V.C.	S.P.S.T., 1A., 250 V.)			
S-5	Tone Control	S.P.S.T. (Part of R-37)			
S-6	B+ "ON-OFF"	S.P.S.T. 1A., 250 V.)			
S-7	A.C. Power "ON-OFF")	)	Ganged J	1570NL	E948-2
S-8	Heater "ON-OFF")	D.P.S.T. 1A., 250 V.)			
S-9	T-6 Primary Selection	D.P.D.T. 1A., 250 V	J	81027-AB	F361-1

SYMBOL NUMBER	FUNCTION	DESCRIPTION	MFR.	MFR. TYPE NO.	NATIONAL DWG. NO.
		TRANSFORMERS			
T-1	V-4 to V-5 Coupling	455 Kc. I.F.	A	IFC-240	SA:895
T-2	V-5 to V-6 Coupling	455 Kc. I.F.	A	IFC-240	SA:898
T-3	Beat Osc. Tuning	455 Kc. I.F.	A	IFCO-240	SA:900
T-4	Phone Output	Audio, 7000/125-250-500 Ohms	A	NP-521	SA:928
T-5	Speaker Output	Audio, 10,000/8-500 Ohms	A	NP-508	SA:1034
T-6	Power Supply	115/230 V, 40/60 Cycles, 150 W.	A	13629	SA:1030
		VACUUM TUBES			
V-1	R.F. Amplifier	R.F. Pentode	K	6SK7	
V-2	First Detector	Triode-Hexode Converter	K	6K8	
V-3	H.F. Oscillator	Triode	K	6J5	
V-4	First I.F. Amplifier	R.F. Pentode	K	6K7	
V-5	Second I.F. Amplifier	R.F. Pentode	K	6SK7	
V-6	Second Det. Limiter	Dual Triode	K	6C8G	
V-7	Beat Oscillator	R.F. Pentode	K	6SJ7	
V-8	Automatic Volume Control	R.F. Pentode	K	6SJ7	
V-9	Audio Phase Inverter	Dual Triode	K	6F8G	
V-10	Speaker Audio Output	Beam Power	K	6V6	
V-11	Speaker Audio Output	Beam Power	K	6V6	
V-12	Phone Audio Output	Triode	K	6J5	
V-13	Power Rectifier	Full-Wave Rectifier	K	80	
		INTERCONNECTING CABLES			
W-1	Power Input to Receiver	6-Wire Shielded & 7-Pr. Plugs	R	None	E512-1
W-2	Not used				
W-3	A.C. Power Input	6', 2-Wire, #18 S.J.	Q	None	SA:1363
		SOCKETS			
X-1	Mounting for V-1	Ceramic, 8-Prong Octal	A	CIR-8	SA:71-2
X-2	Mounting for V-2	Ceramic, 8-Prong Octal	A	CIR-8	SA:71-2
X-3	Mounting for V-3	Ceramic, 8-Prong Octal	A	CIR-8	SA:71-2
X-4	Mounting for V-4	Ceramic, 8-Prong Octal	A	CIR-8	SA:71-2
X-5	Mounting for V-5	Ceramic, 8-Prong Octal	A	CIR-8	SA:71-2

SYMBOL NUMBER	FUNCTION	DESCRIPTION	MFR.	MFR. TYPE NO.	NATIONAL DWG. NO.
		SOCKETS (CONT'D)			
X-6	Mounting for V-6	Ceramic, 8-Prong Octal	A	CIR-8	SA:71-2
X-7	Mounting for V-7	Ceramic, 8-Prong Octal	A	CIR-8	SA:71-2
X-8	Mounting for V-8	Ceramic, 8-Prong Octal	A	CIR-8	SA:71-2
X-9	Mounting for V-9	Ceramic, 8-Prong Octal	A	CIR-8	SA:71-2
X-10	Mounting for V-10	Fiber, 8-Prong Octal	E	6714	E323-1
X-11	Mounting for V-11	Fiber, 8-Prong Octal	E	6714	E323-1
X-12	Mounting for V-12	Ceramic, 8-Prong Octal	A	CIR-8	SA:71-2
X-13	Mounting for V-13	Bakelite, 4-Prong	E	X18-80	E319-10
X-14	Mounting for I-1	Miniature Screw, Part of M-1			
X-15	Mounting for I-2	Miniature Bayonet	O	85UL	C455-1
X-16	Mounting for I-3	Miniature Bayonet	O	85UL	C455-2
		CRYSTAL			
Y-1	Crystal Resonator	455 Kc. Quartz & Holder	A	CR-200	E979-1
		FILTER UNIT			
CF-1	Crystal Filter	455 Kc.	A	CF-200	SA:1158
		R.F. INDUCTORS			
RF-1	R.F. Amp. Transformer	High Frequency Tuning Coil	A	+	
RF-2	First Det. Transformer	High Frequency Tuning Coil	A	+	
RF-3	H.F. Osc. Transformer	High Frequency Tuning Coil	A	+	

Note 1. Capacitor rating is different in each coil range and is individually adjusted as circuit conditions may require; a definite rating cannot be listed.

Note 2. Resistors R-12 and R-19 may have values between 300 and 5,000 ohms since they are chosen to meet the circuit requirements of the particular receiver. The resistance values are determined after careful laboratory test and cannot be changed without impairing performance.

* Used in NC-2-40 only.

\+ Identified by range letter plus stage number, as - - Range A, R.F. Amplifier "A1"; Range C, First Detector "C2"; Range F, H.F. Oscillator "F3"; etc.

° Used in A1 assembly only.

\# Used in E3 and F3 assemblies only.

6.2 List of Manufacturers

A	National Company, Inc.	Malden, Massachusetts
B	Cornell-Dubilier Electric Corp.	South Plainfield, New Jersey
C	Littelfuse Laboratories	Chicago, Illinois
D	General Electric Company	East Boston, Massachusetts
E	Cinch Mfg. Company	Chicago, Illinois
F	P.R. Mallory & Co., Yaxley Division	Indianapolis, Indiana
G	Marion Elec. Instrument Company	Manchester, New Hampshire
H	International Resistance Company	Philadelphia, Pennsylvania
I	Clarostat Mfg. Co., Inc.	Brooklyn, New York
J	Arrow-Hart & Hegeman Company	Hartford, Connecticut
K	RCA Manufacturing Company (Tubes)	Harrison, New Jersey
L	Sprague Products Company	North Adams, Massachusetts
M	Central Radio Laboratories	Milwaukee, Wisconsin
N	Erie Resistor Corp.	Erie, Pennsylvania
O	Alden Products Company	Brockton, Massachusetts
P	Suprenant Elec. Ins. Company	Boston, Massachusetts
Q	Simplex Wire & Cable Company	Cambridge, Massachusetts
R	Gavitt Mfg. Company	Brookfield, Massachusetts
S	Aerovox Corp.	New Bedford, Massachusetts

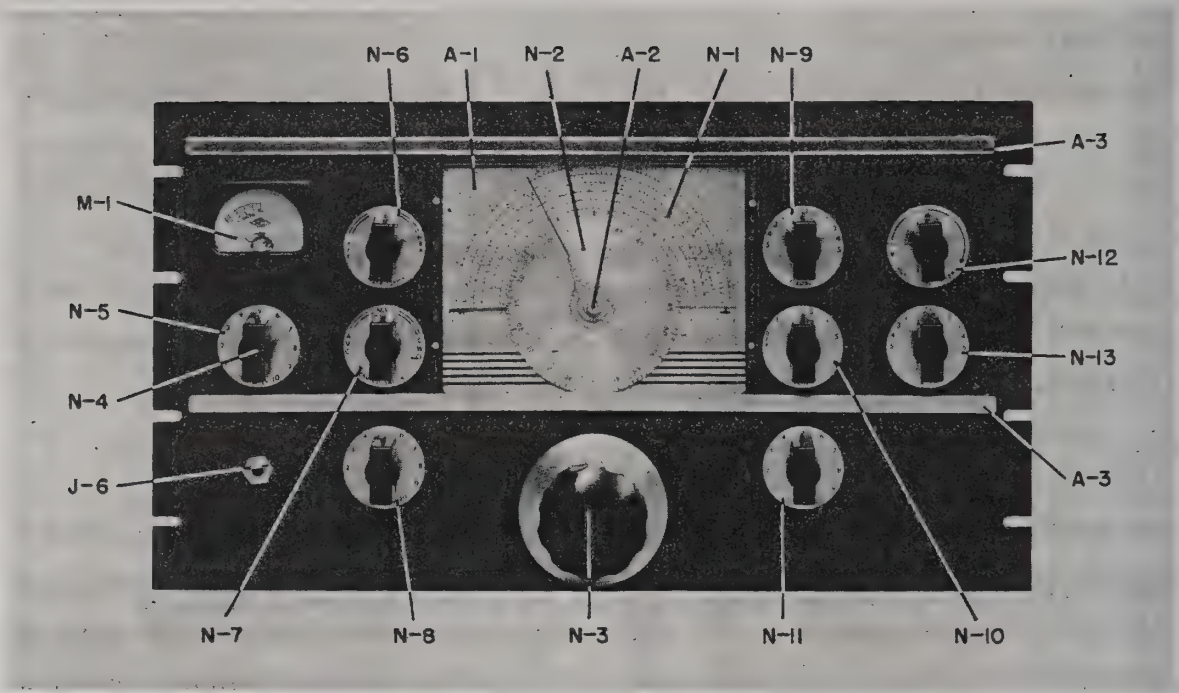


PHOTO NO. 2 RECEIVER FRONT

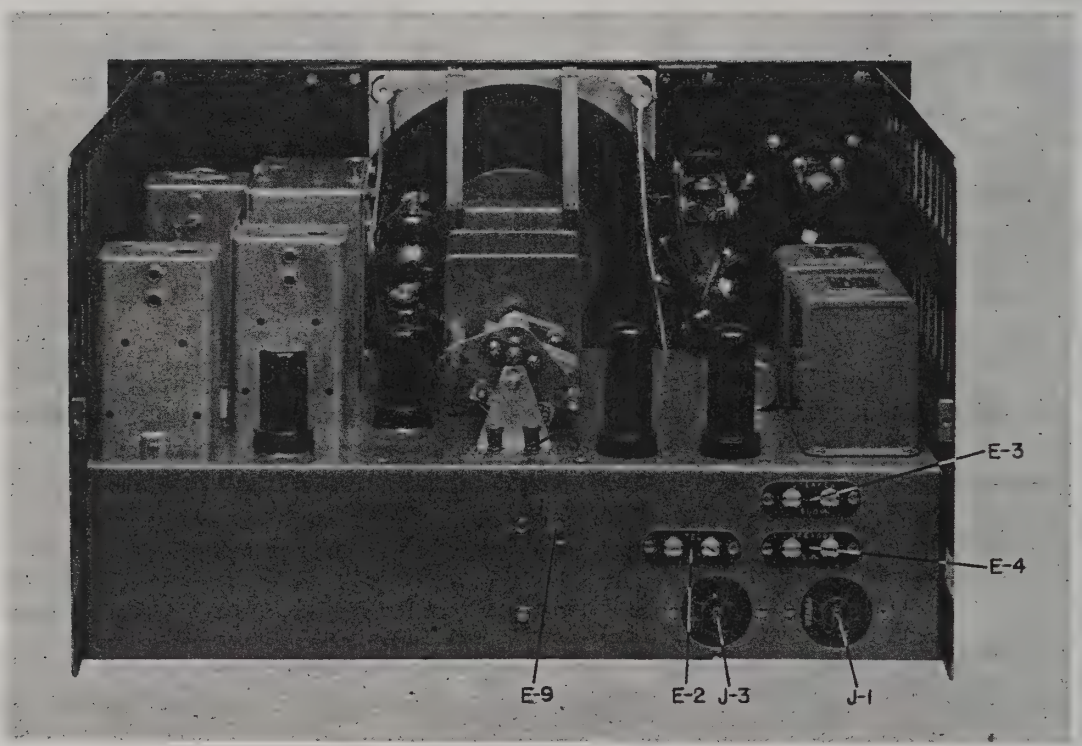


PHOTO NO. 3 RECEIVER REAR

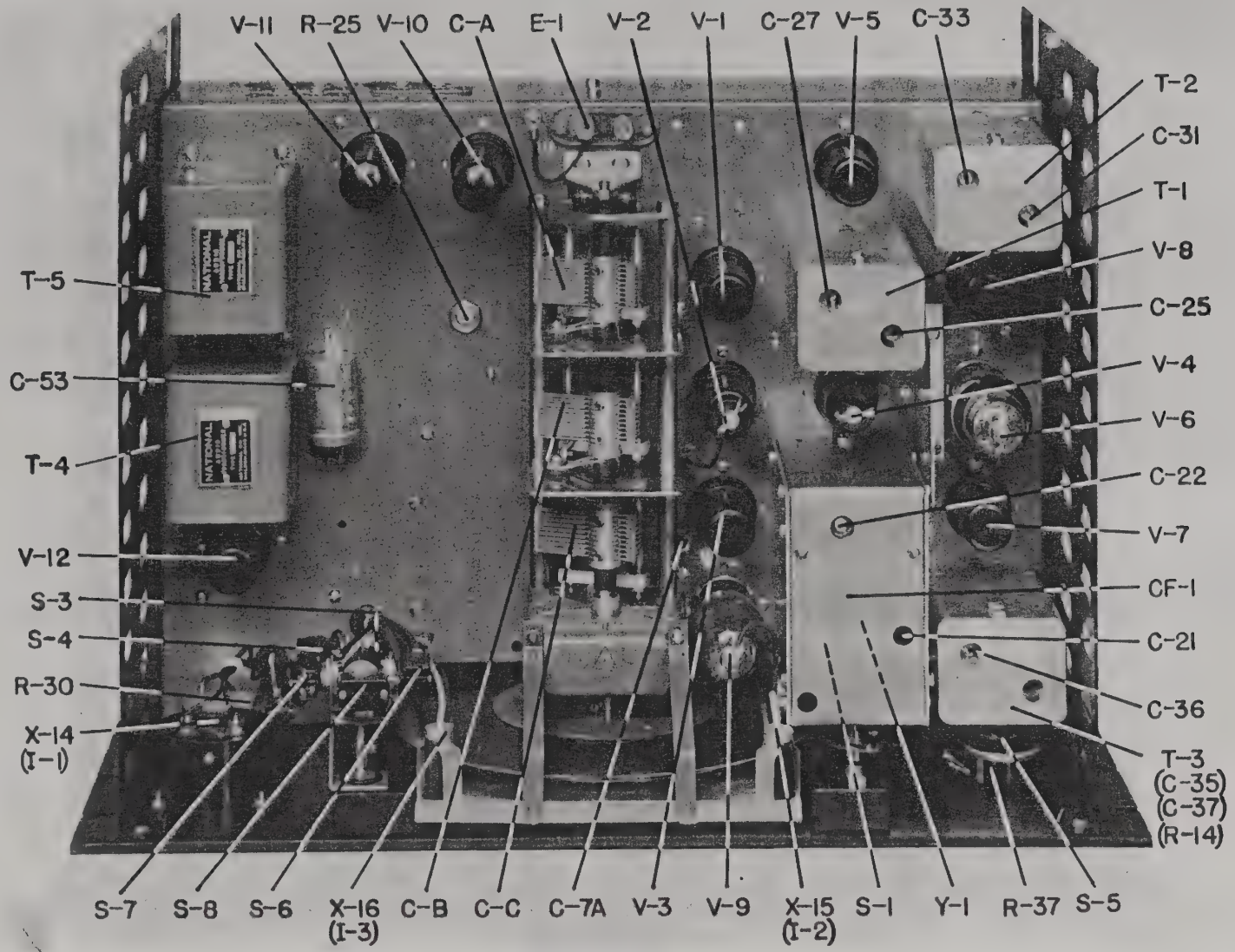


PHOTO NO. 4 RECEIVER TOP

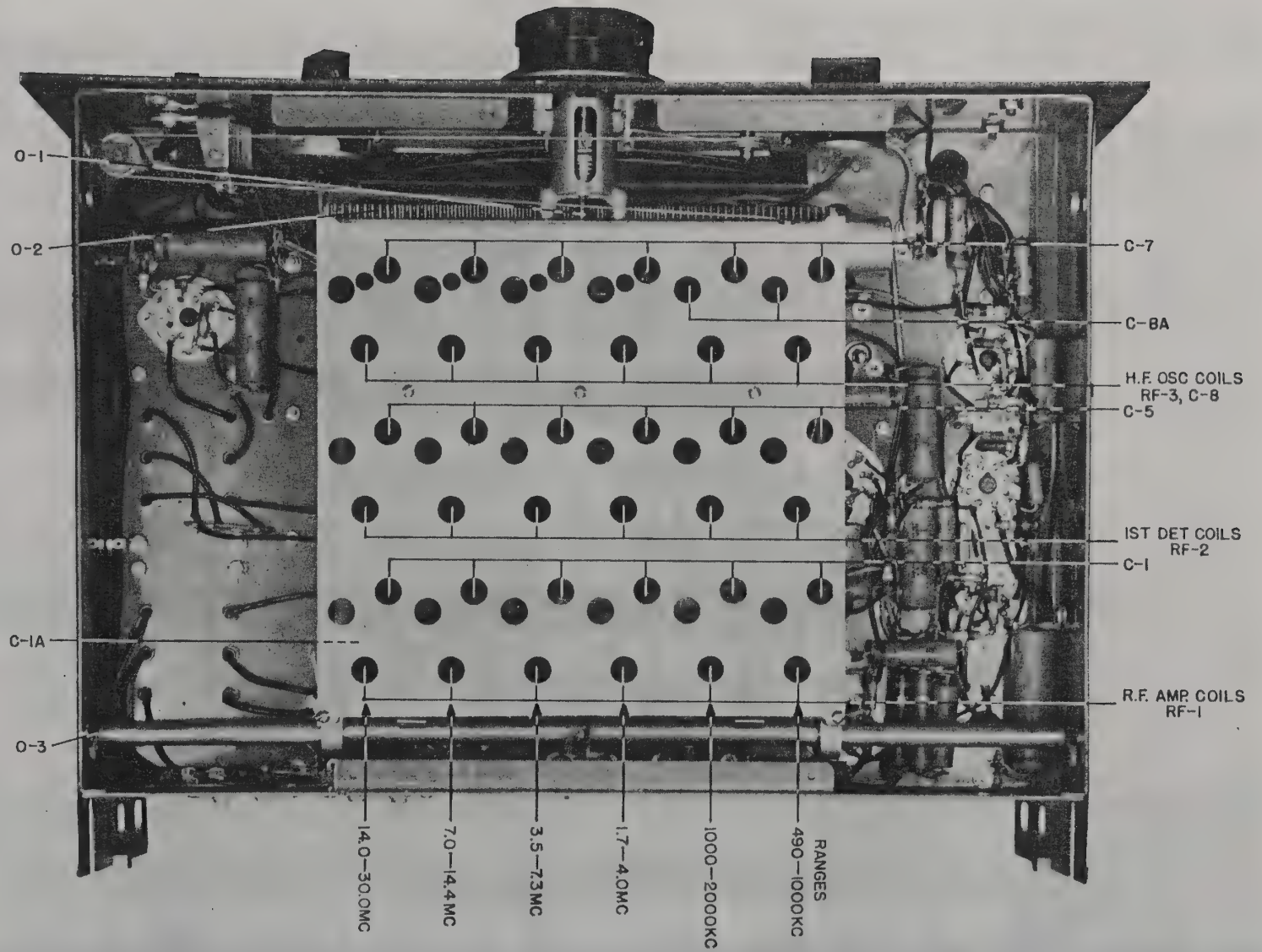


PHOTO NO. 5 RECEIVER BOTTOM

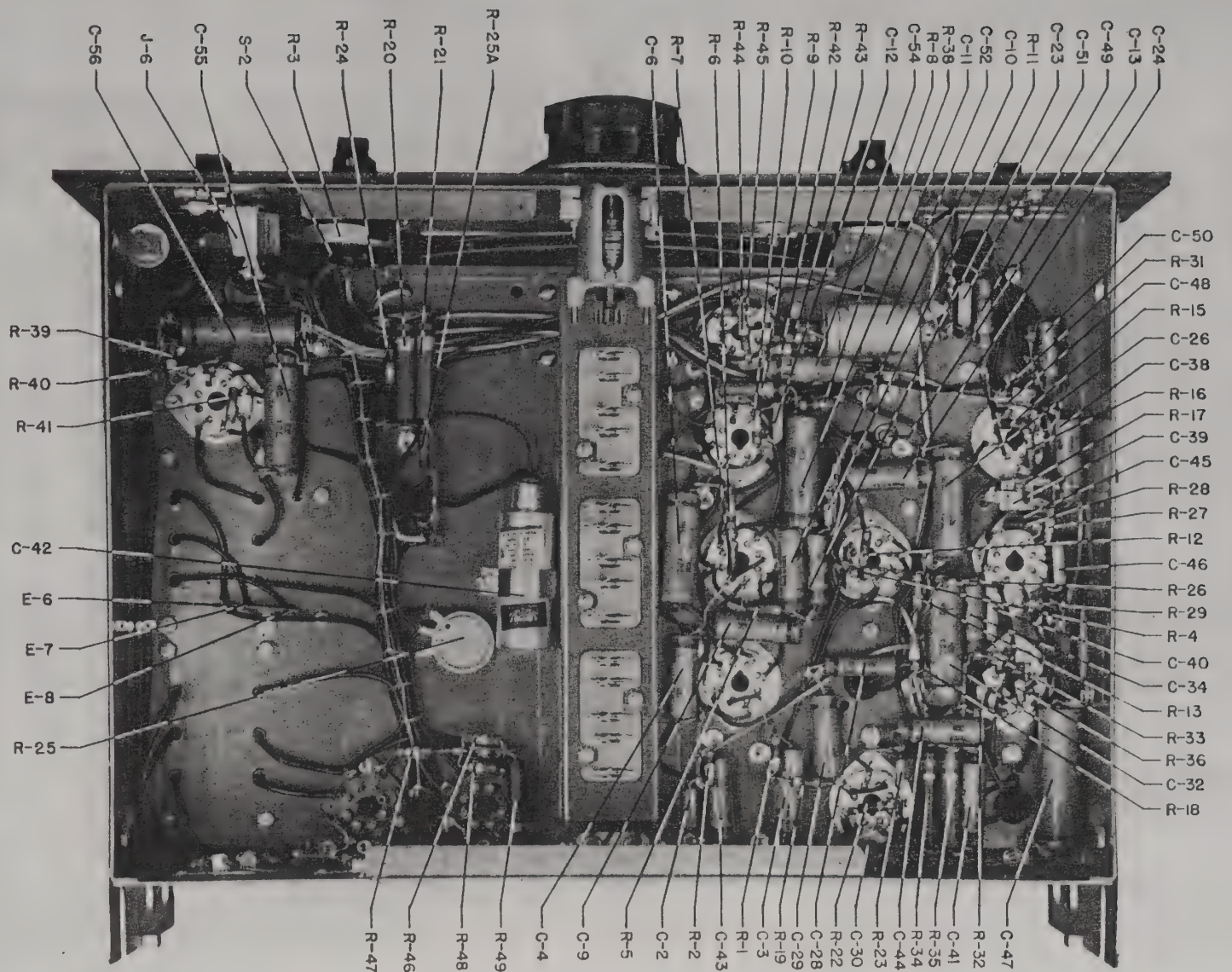


PHOTO NO. 6 RECEIVER BOTTOM - COILS REMOVED

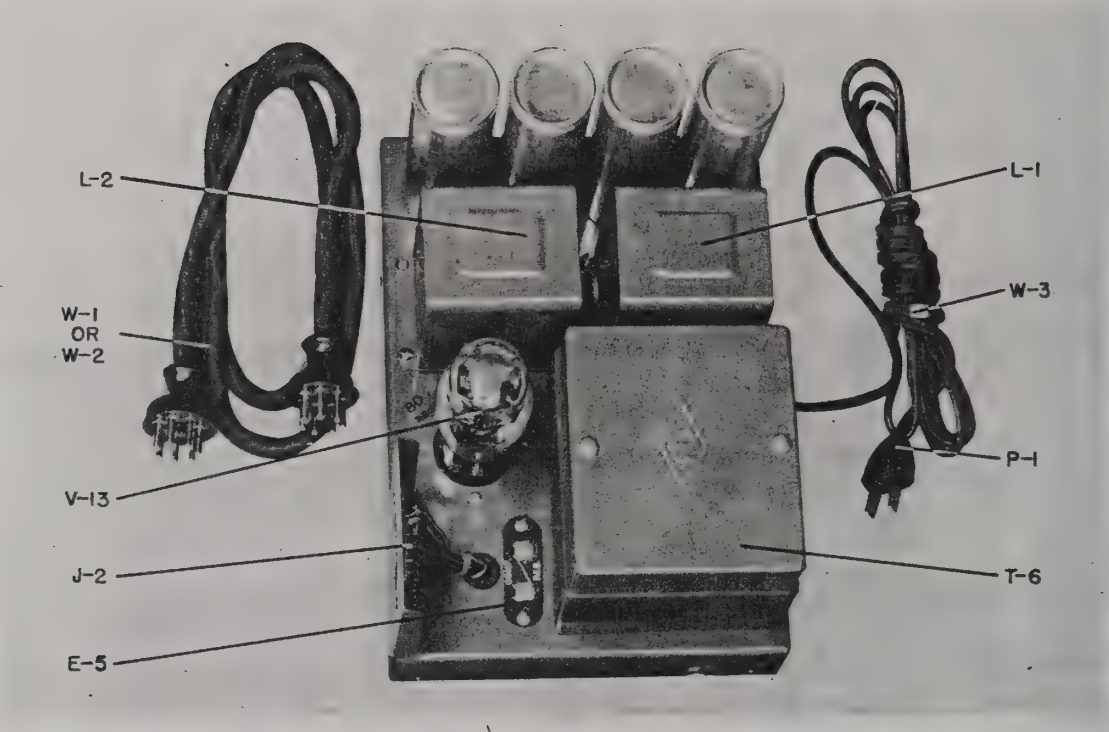


PHOTO NO. 7 POWER UNIT - TOP

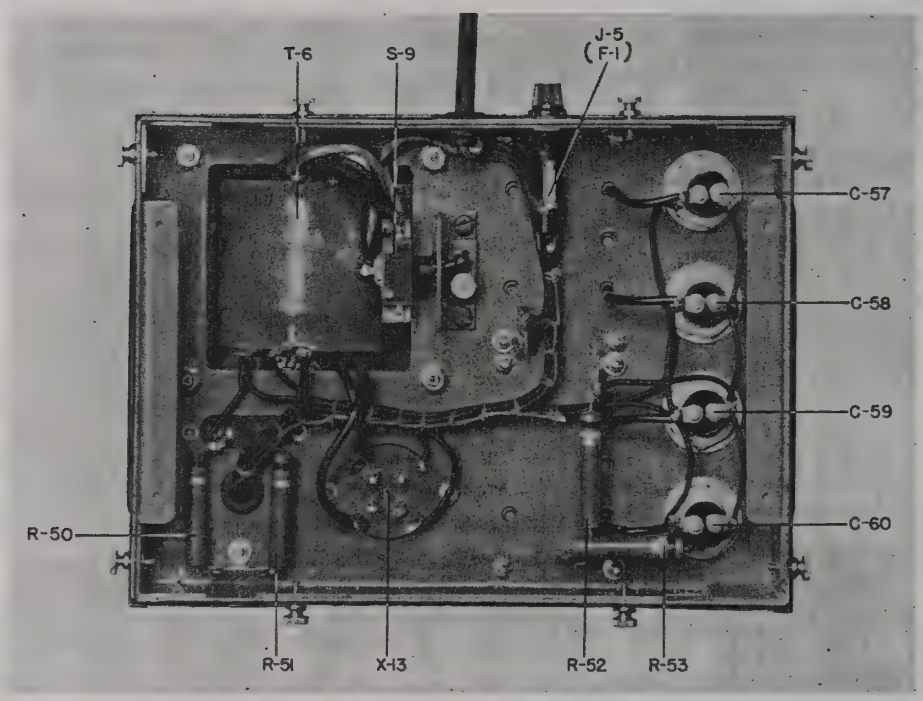
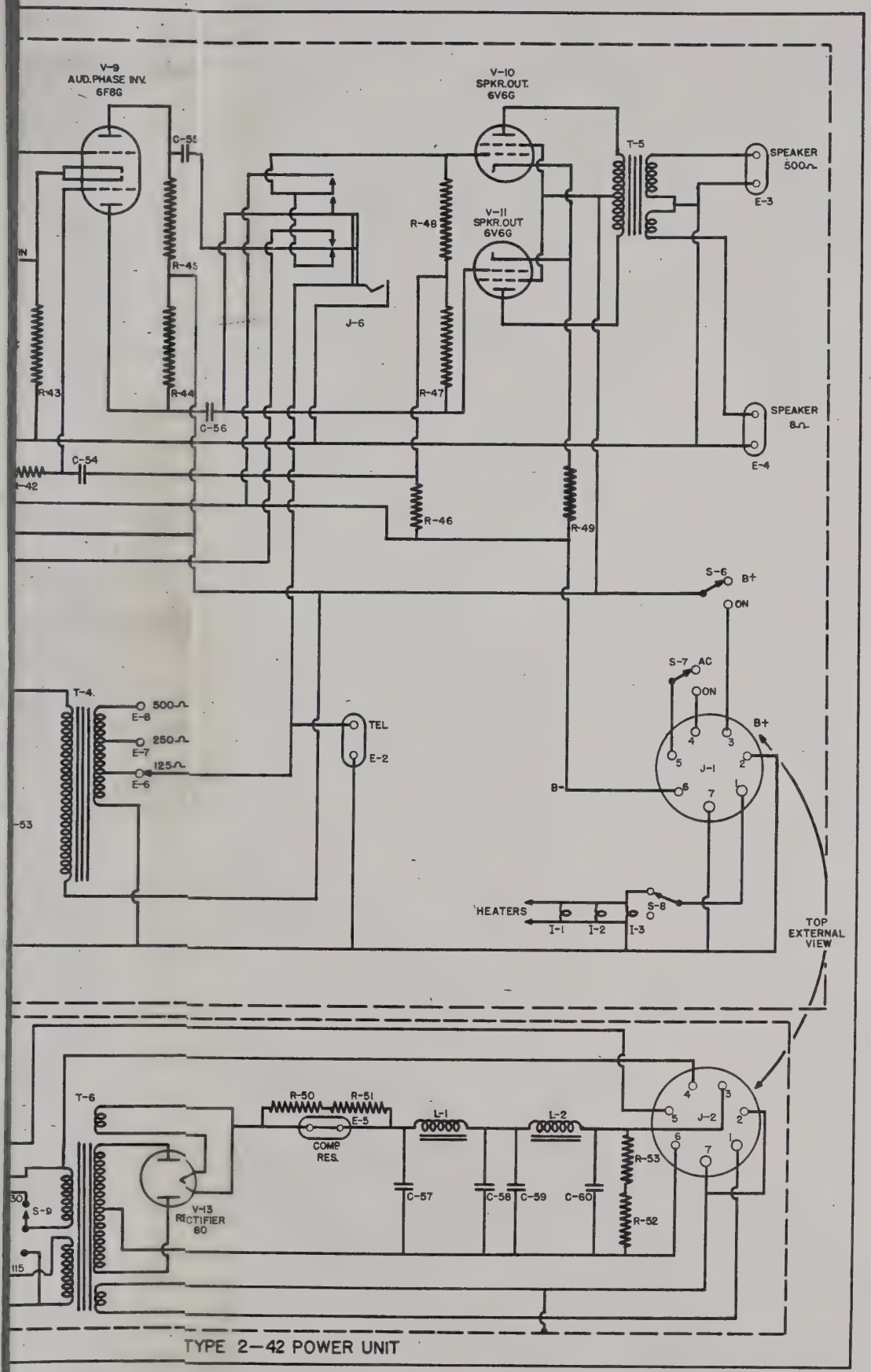
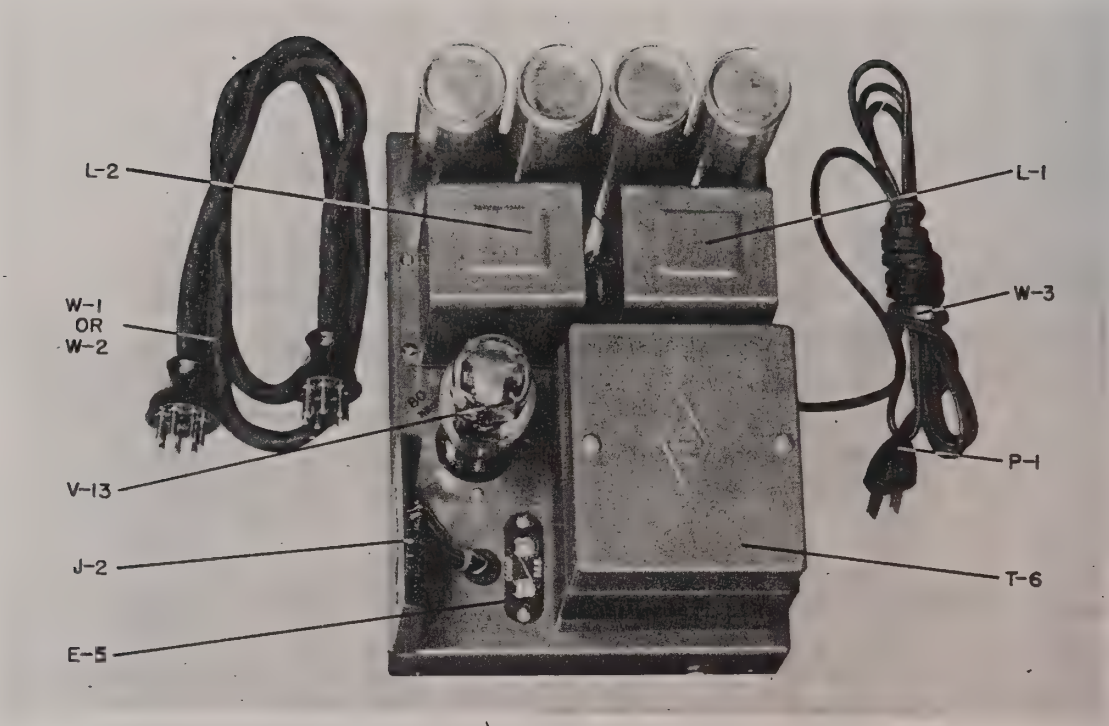


PHOTO NO. 8 POWER UNIT - BOTTOM



DRAWING NO. 1 SCHEMATIC WIRING DIAGRAM



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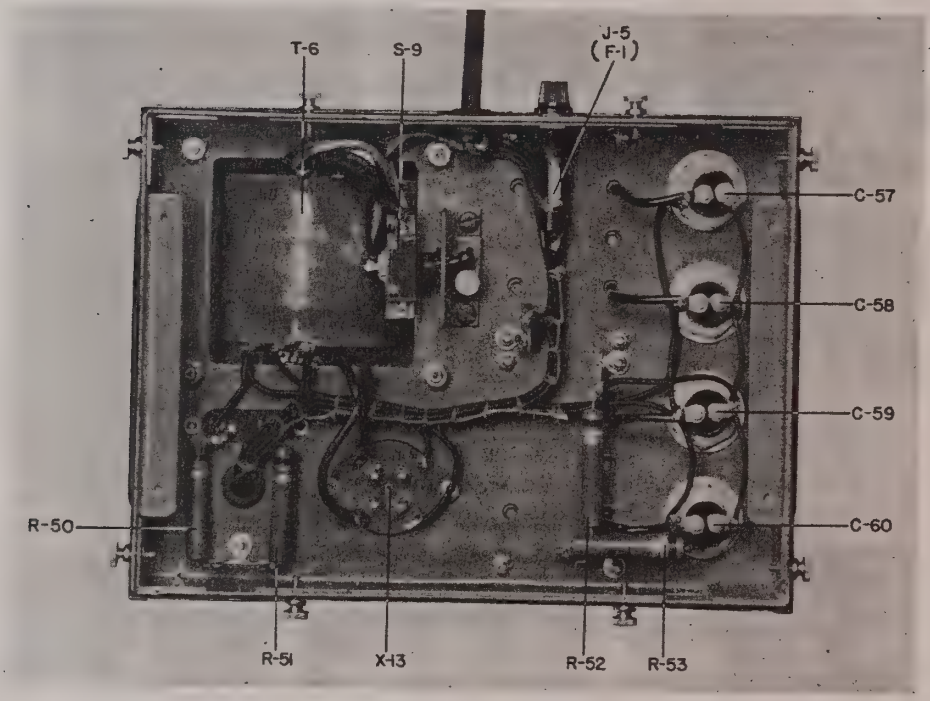

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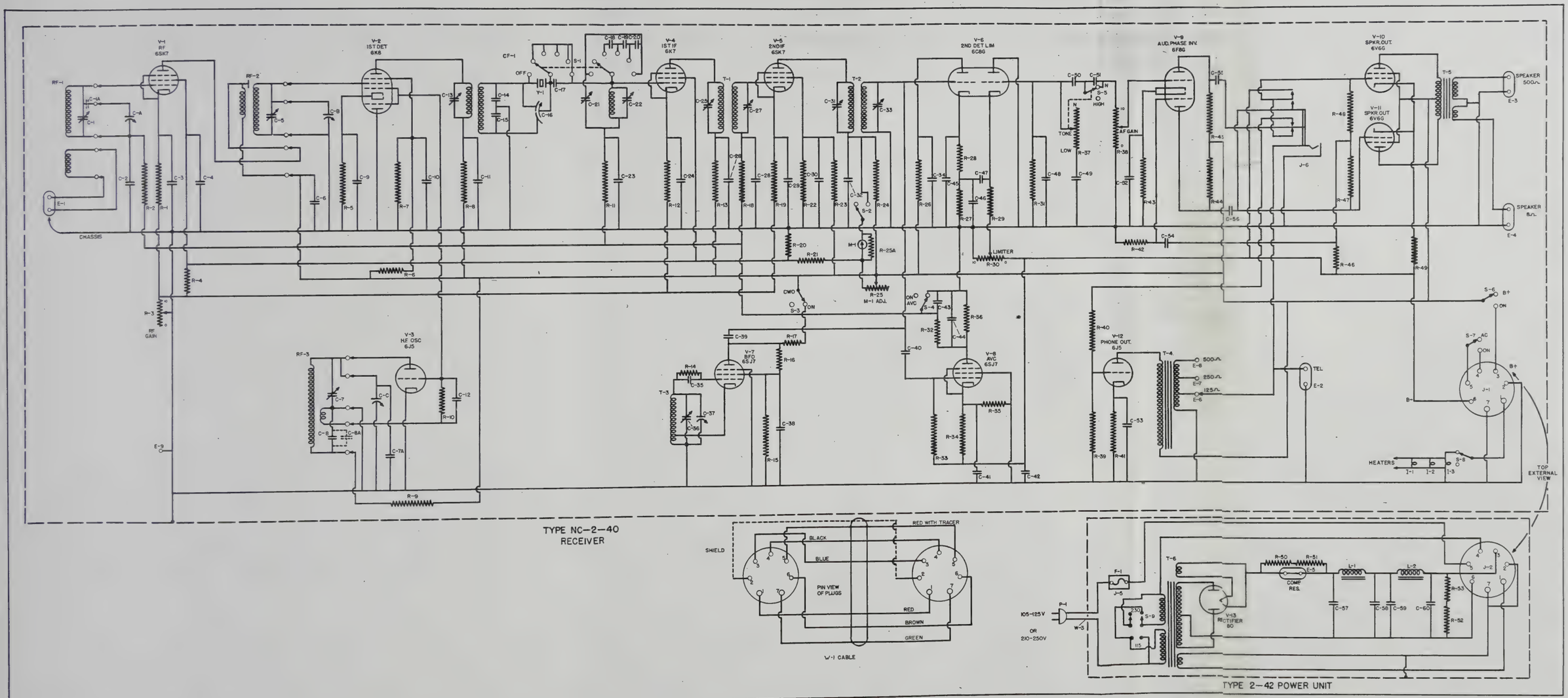
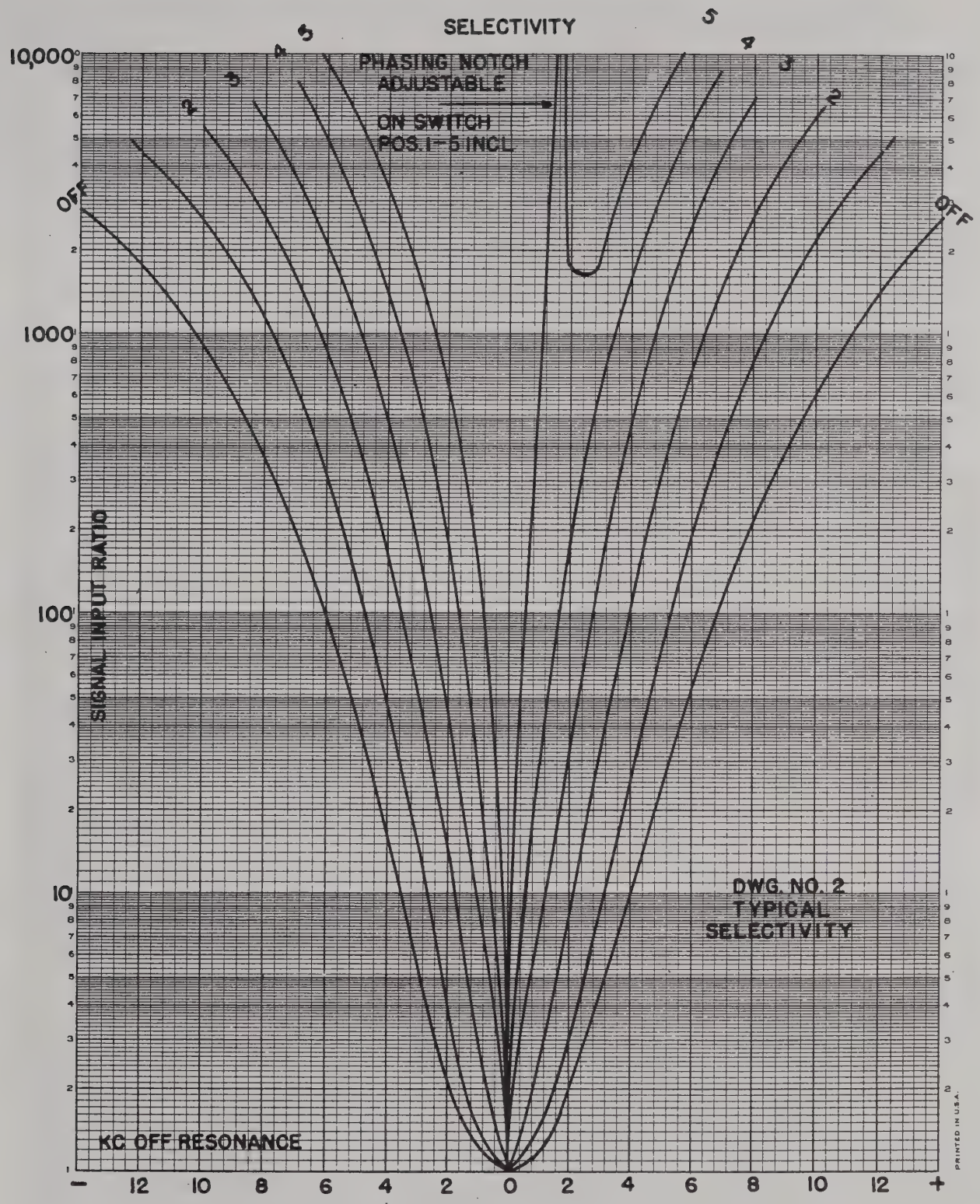
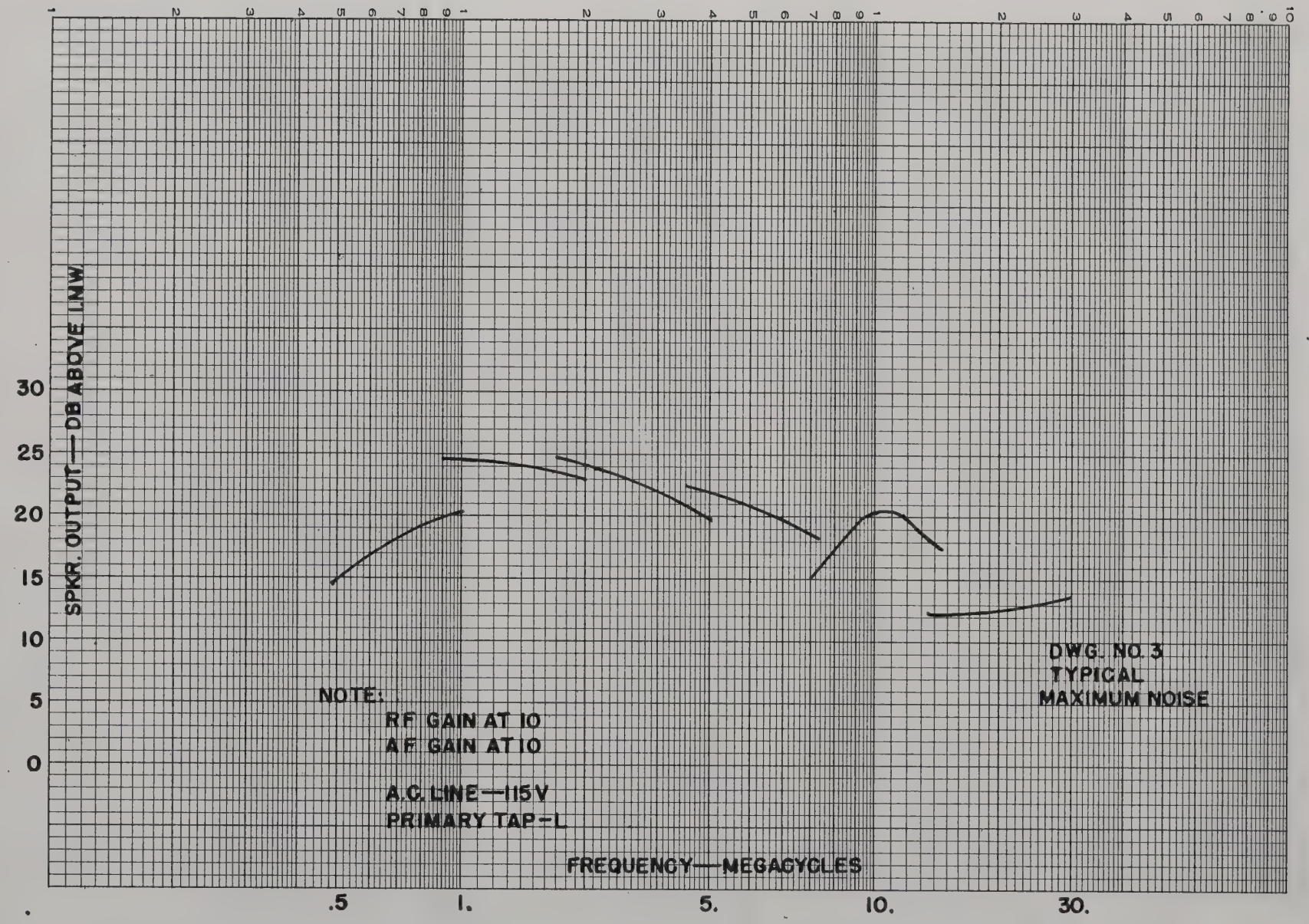


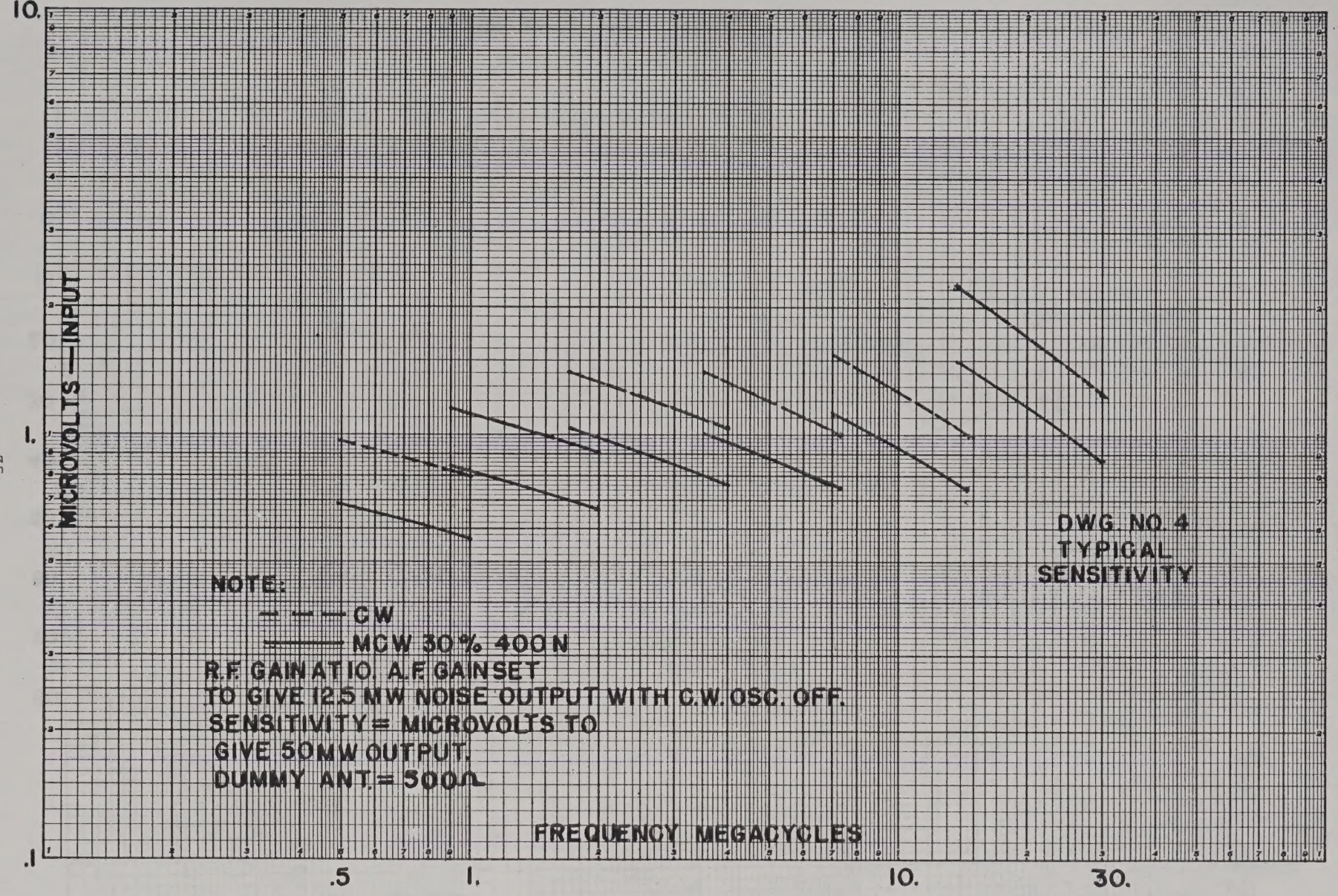
DRAWING NO. 1 SCHEMATIC WIRING DIAGRAM



DRAWING NO. 2 SELECTIVITY CHARACTERISTIC



DRAWING NO. 3 MAXIMUM NOISE



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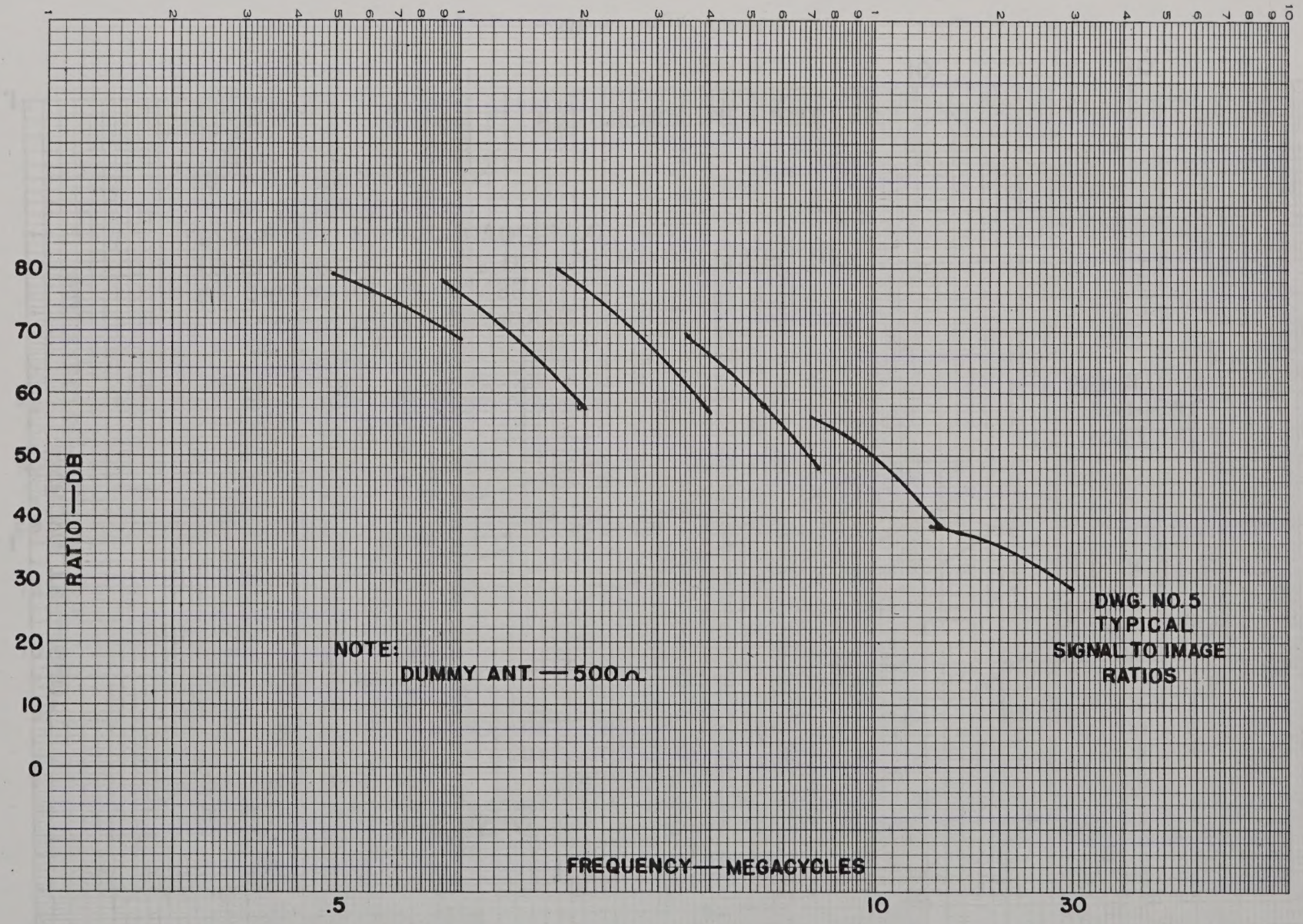

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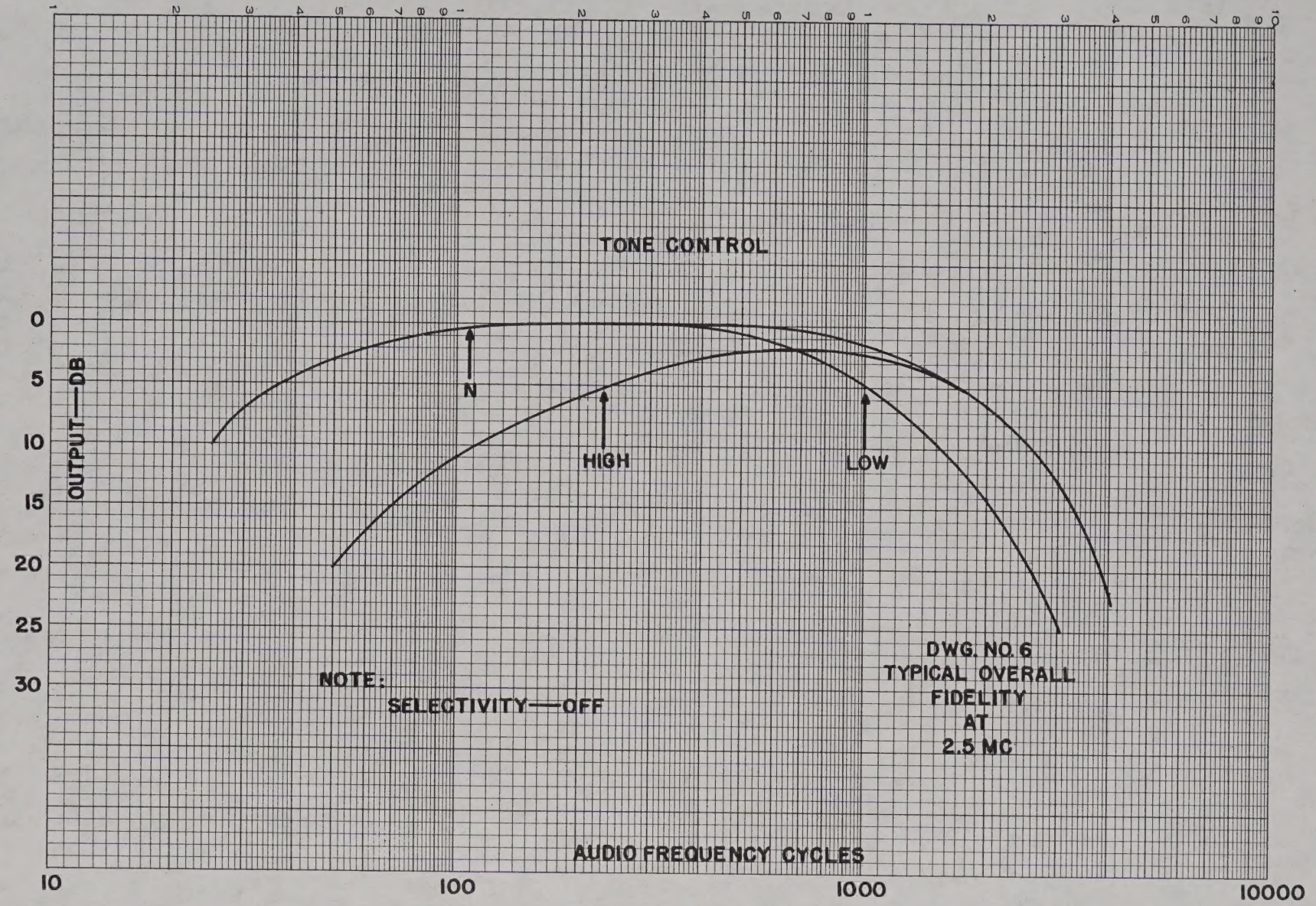

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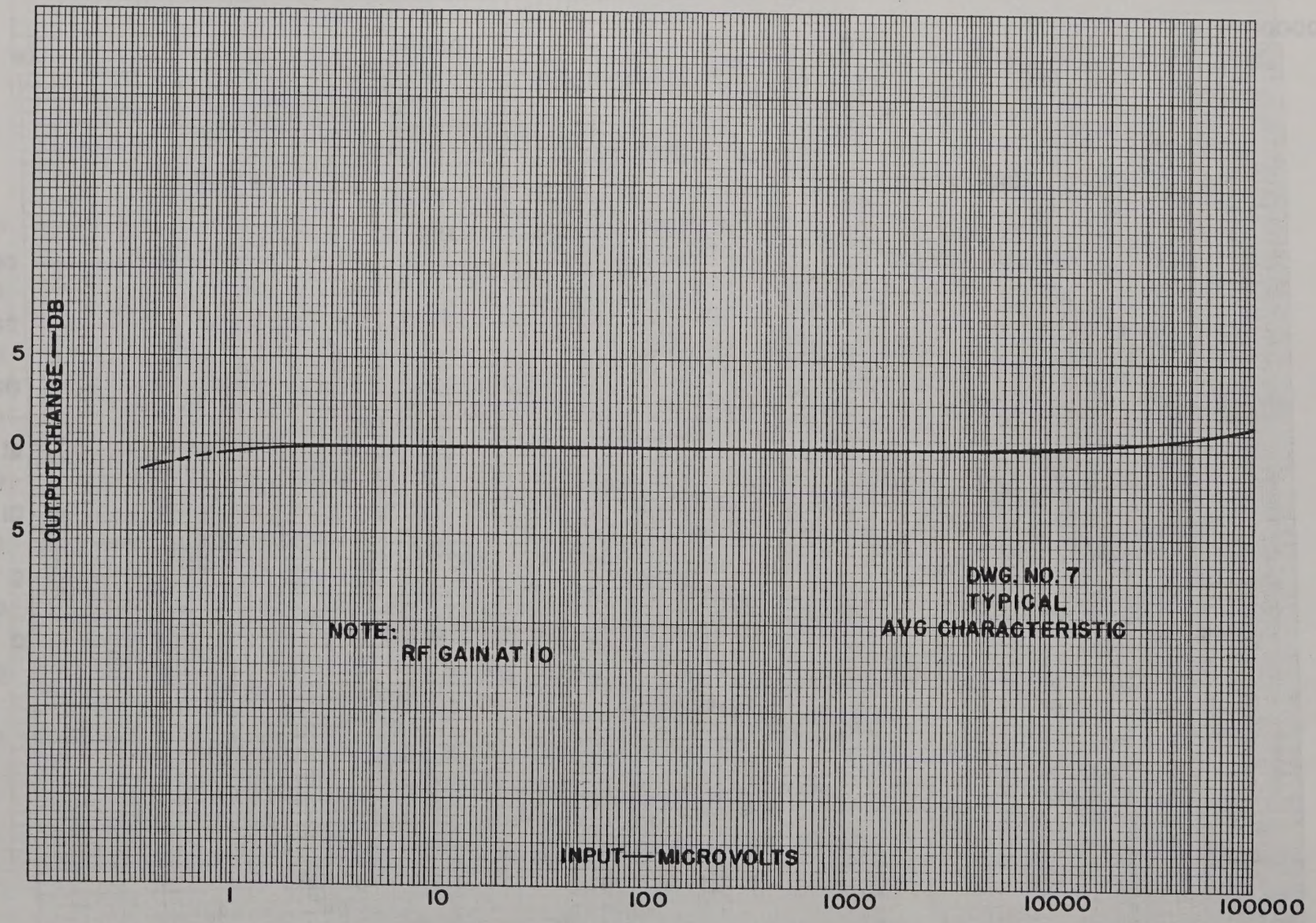

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